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An Investigation of Emissions from Trucks Above 6,000-Lb GVW Powered by Spark-Ignited Engines

Southwest Research Inst, San Antonio, Tex

Prepared for

National Air Pollution Control Administration, Ann Arbor, Mich Procedures and Emissions Background Development Section

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AN INVESTIGATION OF EMISSIONS FROM TRUCKS ABOVE 6,000-LB GVW POWERED BY SPARK-IGNITED ENGINES

by

Karl J. Springer

FINAL REPORT

Prepared for

Procedures and Emissions Background Development Section
Motor Vehicle Research and Development Program
National Air Pollution Control Administration
Contract No. PH 86-67-72
U. S. Public Health Service
Department of Health, Education, and Welfare

March 1969

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This report cover the efforts to make use of three cycles, known as Class II(6,001 to 10,000 GVW), Class III(10,000 to 19,500 GVW),and Class IV(19,501 and above), to survey the emissions from a wide variety of gasoline powered vehicles. The principal emissions of interest were CO, unburned HC,and NO_x and were obtained on a mass, lb/mi basis. Emissions from selected vehicles were studied in detail to correlate the constant volume to the servoproportional and continuous methods. Emissions were then acquired from over 150 vehicles using a specially prepared truck size version of the PHS developed constant volume sampling system. All results are summarized by class and are rank-ordered from "low to high" by CO,HC and NO_x. By equally weighting the emissions, each vehicle's overall contribution was determined. Attempts were made to relate the amount of emissions to year, make, mileage, etc.The results for the same vehicle operated under two applicable cycles were compared.

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FOREWORD

This project was initiated by the Procedures and Emissions Background Development Section, Motor Vehicle Research and Development Program, National Air Pollution Control Administration, U.S. Public Health Service, Department of Health, Education, and Welfare, Willow Run Airport, Ypsilanti, Michigan. The engineering effort on which this report is based was accomplished by Southwest Research Institute, 8500 Culebra Road, San Antonio, Texas, under contract number PH 86-67-72. The author, Mr. Karl J. Springer, was the Project Leader of the research and development work. This project began on June 29, 1967 and was completed March 31, 1969.

The Project Officer cognizant of this project was Mr. Robert W. Olsen, Chief, Certification and Testing Unit, Procedures and Emissions Background Development Section, Motor Vehicle Research and Development Program, National Air Pollution Control Administration, U.S. Public Health Service, Department of Health, Education, and Welfare, Willow Run Airport, Ypsilanti, Michigan 48197. This project was identified within Southwest Research Institute as No. 11-2056-02.

ABSTRACT

As a result of previous NAPCA sponsored work, three non-constant speed procedures were suggested for use in measuring exhaust emissions from gasoline powered trucks larger than half-ton pickup (6000 lb gross vehicle weight - GVW). These chassis dynamometer procedures were intended to reflect actual truck operation on the road. This report covers the subsequent efforts to make use of these three cycles, known as Class II (6,001 to 10,000 GVW), Class III (10,001 to 19,500 GVW), and Class IV (19,501 and above GVW), to survey the emissions from a wide variety of gasoline powered vehicles. The principal emissions of interest were carbon monoxide (CO), unburned hydrocarbons (HC), and oxides of nitrogen (NO_x) and were obtained on a mass, lb/mi basis. Modifications to the suggested experimental cycles were made. SwRI experimental cycle data were compared with previous road course results. Emissions from selected vehicles were studied in detail to correlate the constant volume to the servoproportional and continuous methods. Limited studies were made with the current Constant Speed Federal Cycle to compare exhaust concentrations with results from the experimental cycles. Emissions were then acquired from over 150 vehicles using a specially prepared truck size version of the PHS developed constant volume sampling system. All results are summarized by class and are rank-ordered from "low to high" by CO, HC, and NO_x. By equally weighting the CO, HC, and NO_x emissions, each vehicle's overall contribution was determined. Attempts were made to relate the amount of emissions to year, make, mileage, type engine, service, observed condition, etc. To accommodate the wide variety of engines, transmissions (auto-manual) in current use required additional changes in the experimental cycles. The effect of categorizing a borderline weight vehicle (such as 10,000 or 19,500 lb GVW) in either of two classes was investigated and the results for the same vehicle operated under two applicable cycles were compared. The emissions from a small group of municipal buses and truck-tractors, powered by liquid petroleum gas, were acquired and compared to similar weight gasoline powered vehicles. Future heavy-duty gasoline engine studies were recommended to determine the level of agreement between the current Federal procedure with typical road operation. Results from this project suggest that additional studies of the current constant speed procedure should be made. These further investigations, made with the constant volume sampler, would permit expression of emissions on a mass basis.

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I. INTRODUCTION

The gasoline powered truck comprises about 10 percent of the total vehicles and burns approximately 35 percent of the gasoline consumed in the United States. A great deal of emissions data has been published on automobiles, but there is a significant lack of published emissions data from trucks. For this reason, the U.S. Public Health Service's National Center for Air Pollution Control (NAPCA) initiated a study with Southwest Research Institute to acquire baseline emissions data. Because of the lead time requirements and the need to acquire baseline emission data with "second generation" test procedures, the SwRI program was concerned mainly with emissions from vehicles operated on experimental chassis dynamometer cycles. The experimental cycles employed were basically those developed by an earlier U.S. Public Health Service sponsored study at Ethyl Corporation and described in their final report(1)*. In addition to the use of experimental cycles which involved nonsteady-state engine operation, a special truck version of the new and novel exhaust gas sampling system developed by the U.S. Public Health Service was employed. The original prototype sampling system, known as the PHS Variable Dilution Sampler, was described in an APCA paper(2). This sampler has more recently been known as the PHS constant volume sampler. Part of the preparations phase of the SwRI program involved the design, construction, and calibration of a truck version of the automotive system as was described in a special SwRI report (Appendix A).

This is the comprehensive Final Engineering Report by Southwest Research Institute for the Procedures and Emissions Background Development Section of the NAPCA, U.S. PHS, under Contract PH 86-67-72. The first section covers the preparations and initial emissions results obtained from representative vehicles prior to the acquisition of baseline data from a number of vehicles above 6000 lb gross vehicle weight (GVW). The initial emissions results obtained using a chassis dynamometer are compared with previously obtained emissions data for similar vehicles operated on the Detroit-Los Angeles road course. Once this relationship was established using the PHS servoproportional sampler, experiments were conducted to relate the truck version of the constant volume sampler with the servoproportional sampler. Chassis dynamometer cycles included the proposed 1970 constant speed cycle, as well as several experimental variable speed cycles based on operation of trucks over urban routes.

The second part of this report covers the baseline emissions of over 150 vehicles above 6000 lb GVW. These trucks were tested using the appropriate Class II, III, or IV experimental variable speed cycle in an "as-received" condition. The PHS constant volume sampler was used to gain the baseline data.

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*Superscript numbers in parentheses refer to List of References at the end of this report.

II. OBJECTIVE

The overall objective of this study was to obtain baseline emissions data from gasoline powered trucks using experimental, "second generation" procedures, and the most advanced emissions sampling and analysis methods available. Further development of chassis dynamometer cycles, design and construction of a truck version of the PHS Constant Volume Sampler, and correlation with previous efforts were necessary preparations.

The preparations phase included two major tasks. The first was to establish the relationship between emissions obtained on the simplified SwRI chassis dynamometer and the emissions reported in Reference 1. The second task was to confirm and establish correlation of exhaust sampling by the servoproportional and constant volume sampling systems.

The baseline acquisition phase incorporated two major tasks. First, to measure exhaust gas contents on a mass emissions per distance traveled basis using the truck version of the constant volume sampler. The second task was to determine the variability and applicability of each experimental cycle using a variety of representative trucks.

III. SAMPLING AND ANALYSIS EQUIPMENT, INSTRUMENTS, AND PROCEDURES

Three sampling and analysis systems were used to obtain emission data during the preparation phase. The most familiar sampling and analysis system, the continuous sampler(3,4,5) using nondispersive infrared (NDIR) is described first. The PHS servoproportional system(6), used to obtain all Detroit-Los Angeles (DLA) road course emission data, is discussed next. The prototype truck version of the newest sampling system, the constant volume sampler(7) is also reviewed.

A. Continuous Sampling and Analysis

This exhaust gas sampling and analysis system (shown in the center of Fig. 1) is specified under Federal regulations(7) and used for testing of spark-ignited, gasoline-fueled vehicles. A component description of the system includes a regulated exhaust gas flow rate through water condensate traps to four, rapid and continuous NDIR analyzers. The analysis system consists of a carbon monoxide (CO) analyzer,

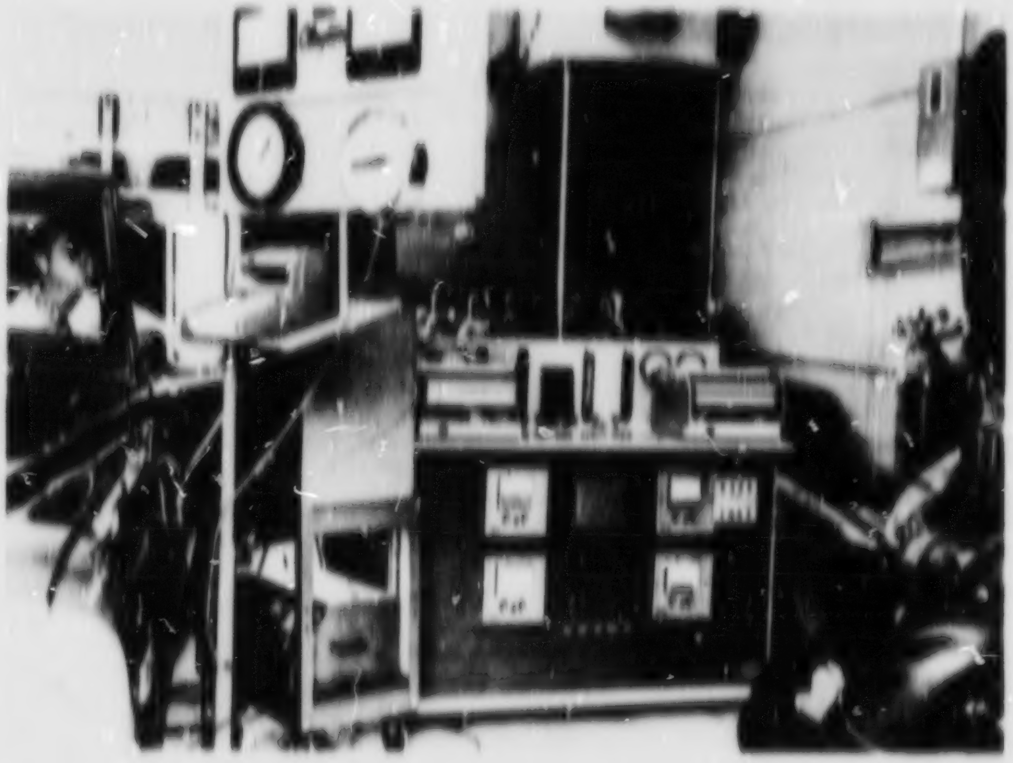

FIGURE 1. CONTINUOUS SAMPLING AND ANALYSIS SYSTEM

0 to 11 percent CO, a carbon dioxide (CO_2) analyzer, 0 to 16 percent CO_2, and two hydrocarbon (HC) analyzers, 0 to 1000 ppm HC and 0 to 10,000 ppm HC as normal (n) hexane (C_6H_{14}). The continuous analysis readout is accomplished almost instantaneously via two dual-pen strip chart recorders. The present system does not include instrumentation for the measurement of the oxides of nitrogen (NO_x); however, suitable NDIR instrumentation available for the measurement of nitric oxide (NO) and nondispersive ultraviolet (NDUV) for nitrogen dioxide (NO_2). Use of the continuous system for surveillance testing involves momentous data reduction; however, computers are helping to overcome this problem. The system measures only concentration of contaminants and conversion to a mass basis is by computation(7).

B. PHS Servoproportional Exhaust Sampling System

This exhaust sampling and analysis system has been used for several years to gain road course data for developing test cycles. The *principle* of operation permits the collection of a representative sample of exhaust gas in a moving vehicle by diverting and retaining a fixed percentage of the total airflow for later analysis.

A typical servoproportional sampler system is shown in Figures 2 and 3, connected to a vehicle undergoing a chassis dynamometer test. This system is composed of three items, a laminar flow element, an operational console, and a detachable bag box servo control sampler. The console is shown nearest the driver in Figure 2. The bag box, not shown, is located near the exhaust pipe of the vehicle. A spare servo bag box is shown against the wall in the background of Figure 2. A sensitive differential pressure transducer is used to measure the pressure drop across the laminar flow element located in the carburetor air intake as shown in Figure 3. A similar pressure transducer measures the drop across a laminar flow unit in the sample flow line. The DC signal from the pressure transducers to the summing amplifier gives a resulting error signal through a power amplifier that drives a control valve which meters the sample flow. By maintaining a zero error signal, the ratio of sample intake to exhaust flow is about 1 to 1000.

The 0.1 percent exhaust sample is collected throughout the test schedule in a Tedlar®* bag, resulting in an integrated sample. This exhaust gas is prediluted with a fixed volume of nitrogen to "freeze" the chemistry of the exhaust. The fixed amount of diluent is accounted for in the calculation of mass emissions. The analysis of exhaust gases in the Tedlar® bag requires a suitable array of NDIR instruments for measuring the CO, CO_2, and HC as n-hexane, and flame ionization detector (FID) to measure total hydrocarbons as shown in Figure 4. Measurement of the oxides of nitrogen is usually accomplished by means of the modified Saltzman syringe technique. More recently, NO, about 99 percent of the NO_x in the tailpipe, has been measured by a dual range NDIR.

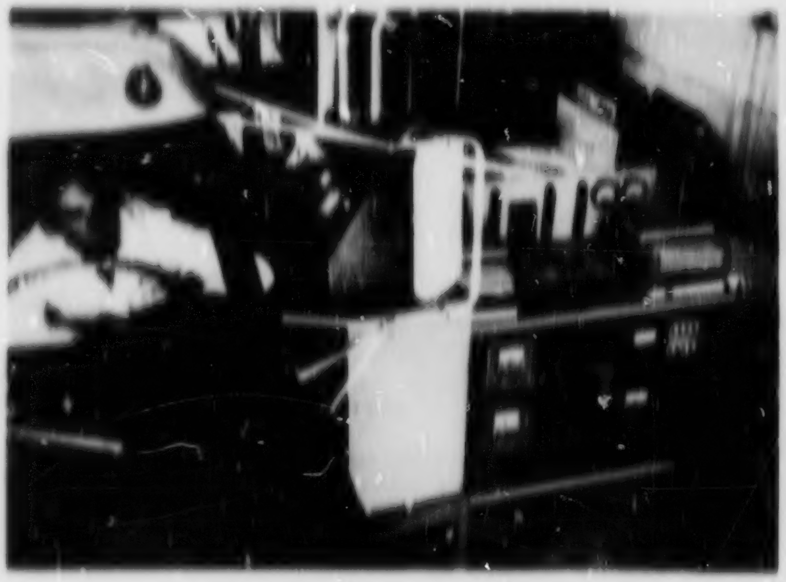

FIGURE 2. SERVOPROPORTIONAL SAMPLER CONTROL UNIT AT DRIVER'S SIDE AND SERVOPROPORTIONAL SAMPLER UNIT WITH SAMPLE BAG CONTAINER IN BACKGROUND

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*E. I. duPont de Nemours and Company, Inc.

FIGURE 3. CLASS II TRUCK EQUIPPED WITH SERVOPROPORTIONAL SAMPLER LAMINAR FLOW ELEMENT AND PRESSURE TRANSDUCER

FIGURE 4. NONDISPERSIVE INFRARED, NONDISPERSIVE ULTRAVIOLET, AND FLAME IONIZATION INSTRUMENTS FOR EXHAUST EMISSION ANALYSIS

C. PHS Constant Volume Sampling System

This sampling system is a recent PHS development using the integrated bag sample technique. The sampler dilutes the total exhaust gas flow with ambient air such that a constant total flow results. The particular sampler used to gain gasoline truck baseline emissions was an enlarged version of the PHS automotive prototype in that the sampling system can handle the increased exhaust flow at higher temperatures emitted from truck-size engines.

The resulting truck version of the constant volume sampling system is shown in Figure 5. The total flow of exhaust gas and diluent air is pulled in through an inlet cone (shown in Fig. 6) that serves to reduce the

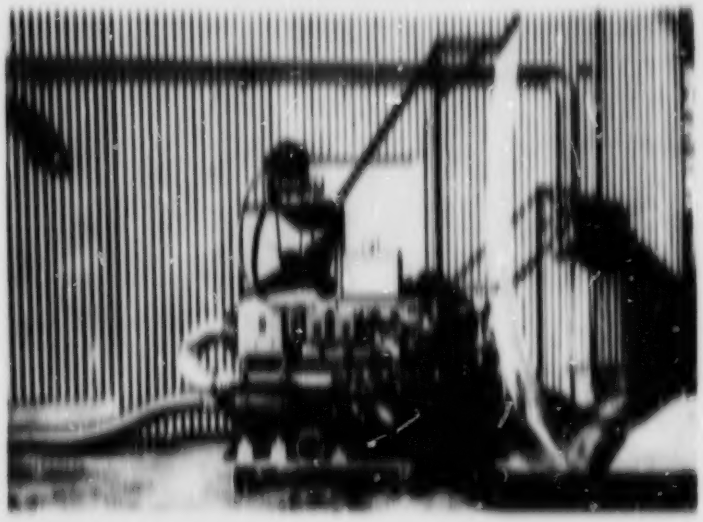

FIGURE 5. TRUCK VERSION OF THE CONSTANT VOLUME SAMPLER

FIGURE 6. TOTAL EXHAUST FED INTO INLET CONE OF CONSTANT VOLUME SAMPLER

inlet effects. The diluent sample flows through a flexible stainless steel pipe to the larger "U" shaped, air-to-exhaust, shell and tube, stainless steel heat exchanger. This heat exchanger serves as a heat sink for the moving exhaust gases; that is, the rapid exhaust gas temperature changes are reduced to a minimum so the mode changes are not seen at the inlet to the blower. The removal of the diluent sample by the isokinetic probe is just upstream of the two-speed, positive displacement pump. This two-speed pump gives the sampler the unique capability of operation of 950 cfm for the large truck-tractor gasoline engine and 635 cfm for medium-size gasoline truck engines (about three and two times the automotive capability, respectively).

Regardless of the sampler system pump speed, a constant flow of 4 cfm is extracted from the main diluent sample line through a nickel-plated sample pump. This "split-off" of representative sample is deposited in a large 4 by 9-ft Tedlar® bag during the cyclic testing. All portions of the sampling system in contact with the diluent exhaust sample are fabricated of stainless steel and Teflon®[*]. A description of the redesigned, repackaged, truck version of the constant volume sampling system was presented in an earlier special report and is included as Appendix A of this report.

The analytical procedure used with the constant volume sampler was similar to the servoproportional sampler. A suitable array of NDIR instruments to measure CO, CO_2, and HC as n-hexane, and FIA instruments to measure total hydrocarbons is used, as shown in Figure 4. The oxides of nitrogen are measured using the modified Saltzman method. A small Tedlar® transfer bag is used to bring the sample collected in the large constant volume sample bag to the NDIR and FIA cart.

An important factor that must be considered in analyzing the diluent exhaust gas sample from the constant volume sample is the diluent air. In contrast with the nitrogen diluent (servo method) which is obtained free of contaminants, the large quantities of atmospheric air used as a diluent can contain HC, CO, and NO_x; therefore, a background bag of air, taken during the run, must be analyzed. Using the ratio of air-to-exhaust as a means of weighting the background concentration, the additional concentration may be subtracted out of the final analysis of the exhaust gas.

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[*] E. I. duPont de Nemours and Company, Inc.

IV. TEST VEHICLES AND EQUIPMENT

One objective of this study was to relate actual road course emissions to chassis dynamometer emissions. A discussion of the chassis dynamometer configuration used and a description of the correlation vehicles are included in this section. The vehicles used for baseline data are described in a later section.

A. Chassis Dynamometer Equipment and Operation

Two chassis dynamometers were employed during preparations and baseline data acquisition. The dynamometers were of water brake type and are shown, with the inertia simulation systems, in Figures 7 and 8. For procedural development and baseline data with the Class II vehicles (6,001 to 10,000 lb GVW), the single-axle machine in Figure 7 was used. Baseline data with Class III (10,001 to 19,500 lb GVW) and Class IV (19,501 lb GVW and up) vehicles was also obtained with this dynamometer. It is a Clayton CT-200 and is capable of absorbing up to 200 hp. This dynamometer is coupled to a solid disc flywheel arrangement also shown in Figure 7. The flywheels can be coupled in such an arrangement that a minimum of 1,500 to 16,000-lb maximum equivalent inertia, with any 250-lb increment in between, can be simulated. This system also incorporates a 50-hp, three-phase, AC electric motor that can be used to maintain a constant speed operation as either a power absorbing or motoring unit. This motor can be readily disconnected via the motor slider mounts and a large timing belt.

Procedural development for Class III and IV vehicles as well as limited baseline emissions was accomplished on the tandem axle unit shown in Figure 8. The dynamometer is a Clayton CTFF-200 × 200 capable of absorbing up to 200 hp from two drive axles. Simulation of heavy-duty vehicle inertia is accomplished by the large, solid disc flywheels shown in the background of Figure 8. Vehicle inertia of 16,000-lb weight may be simulated by each axle as well as 25,000 lb on one (the front) axle.

The load characteristic of both water brake chassis dynamometers is to follow the "q" load curve; i.e., it closely simulates the operation of a vehicle where load increases exponentially with increasing vehicle speed.

FIGURE 7. SOLID DISC FLYWHEEL INERTIA SYSTEM CAPABLE OF SIMULATING 1,500 TO 16,000 LB INERTIA IN 250 LB INCREMENTS

FIGURE 8. SwRI TANDEM AXLE CHASSIS DYNAMOMETER AND VEHICLE INERTIA SIMULATION FACILITY

The combination of "q" power absorption, which is most effective at higher vehicle speeds, and inertia simulation by flywheels, which is most effective at low vehicle speeds, results in overall close simulation in the laboratory of actual vehicle operation.

B. Vehicles Used for Procedural Development

Several vehicles were used for the initial familiarization, procedural development, and correlation. As it was desired to determine the level of correlation of the SwRI results to those reported in Reference 1, the same vehicles were used where possible. Although this was done for Classes III and IV, the SwRI Class II vehicle has not been studied previously. The Class III and IV studies at SwRI were initiated shortly after the previous program permitting reuse of rental vehicles in essentially their same condition. The Class II studies, however, were not initiated until over a year had lapsed. This lapse in time precluded valid correlations and comparison as vehicle emissions can vary greatly with type and amount of operation and repair. Also, correlation to the previous program results was already established by the Class III and IV trucks, making additional correlation unnecessary. All vehicles utilized for procedural development and correlation purposes were selected on the advice and with the consent of the Project Officer.

Class II Vehicle Description. The Class II vehicle was a 1968, 10,000-lb GVW Chevrolet truck powered by a 250-cubic inch displacement (CID) inline, six-cylinder engine. This unit, judged to be a representative Class II truck, was selected because of its low mileage and satisfactory performance under a one-half payload road condition.

The 1968 Chevrolet stake body, single-axle truck was equipped with a four-speed transmission, 8.25 × 20 tires, and had an N/V ratio of 53.6. N/V ratio is defined as the number of engine revolutions per vehicle mile traveled. The tare weight was 4300 lb. This relatively new vehicle, with 6000 miles, had no emission control device. Preparations to the vehicle included a minor tune-up of ignition (plugs, points, condenser, wires, distributor calibration) and carburetion. Idle speed and ignition timing were adjusted to factory specifications.

An additional Class II vehicle was employed to explore the ability of the dynamometer procedure to handle trucks with smaller engines. This truck was a 1963 Ford, 10,000-lb GVW stake truck powered by a recently rebuilt 223-CID, six-cylinder engine. This vehicle had a four-speed transmission, 7.50 × 16 tires, with N/V of 48.5.

Class III Vehicle Description—The Class III correlation truck was a 1965 Chevrolet C-60 van type, single-axle truck with a 292-CID, six-cylinder engine, four-speed transmission with a single-speed rear axle. The unit had a gross vehicle weight of 19,500 lb with tire size of 8.25 × 20, an empty or tare weight of 8310 lb, and an N/V ratio of 54.3. This rental vehicle (Whit's No. 13, Ypsilanti, Michigan) was the only Class III correlation truck studied by SwRI.

Class IV Vehicle Description—The initial Class IV truck selected was a 1966 International Harvester (IH) Model LS 1700 stake body truck with single rear axle. This vehicle was powered by an IH 345-CID, V-8 engine through a five-speed transmission and single-speed 6.50 : 1 rear axle, N/V ratio of 56.2, and was equipped with 9.00 × 20 tires. The GVW of this truck was 24,000 lb with an empty weight of 9030 lb. This truck was obtained from the Hertz rental agency in Detroit, Michigan.

The two rental vehicles (Class III Whit's Chevrolet and Class IV Hertz IH) were two of the vehicles utilized in the previous project. According to the rental agencies, no engine or driveline maintenance had been performed between the time they were originally investigated and when they were obtained by SwRI. As far as is known, the two vehicles were essentially the same as when originally studied.

An additional Class IV truck was utilized to further investigate the experimental Class IV cycle and correlation with previous results. This vehicle, obtained from General Motors Research, was a 1967 Chevrolet C-60 stake body truck powered by a 1966 Chevrolet 366-CID, V-8, with two-barrel carburetor. The remainder of the driveline included a five-speed Clark Equipment Model 285 VI transmission and a DI-290 differential with Eaton two-speed (32413). This 24,000-lb GVW truck was identified as number C-76138. According to the information obtained from the Project Officer, the vehicle was powered by the same engine that powered the median Class IV truck identified as No. 16M797(1) which was a 30,000-lb GVW truck. Since the original median truck was rated at 30,000 lb GVW, all tests at SwRI were performed at the 30,000-lb rating. The N/V ratio was 62.7 for the Reference 1 median truck, while the N/V ratio for the truck studied at SwRI was 61.6.

C. Special Sampling Equipment

Provided by the NAPCA as government furnished property were two Pace proportional sampling systems. Each system included a laminar flow element with intake air cleaner housing adapter and operational console with detached servo bag box. The bag boxes were large size for use with trucks. In addition, the same flow balanced carburetors and calibrated distributors used during the original studies of the Class III and the Class IV vehicles were furnished. These special items of equipment were employed by SwRI during procedural development and were essential for direct comparison of SwRI and previous results. Accordingly, the same vehicles, sampling systems, and analysis procedures were employed throughout the Class III and IV correlation studies.

D. Test Fuel

Indolene motor fuel (American Oil Company), meeting the specifications of Paragraph 85.101 (Par. 85.71A) of the Federal Register dated June 4, 1968,(3) was the only fuel utilized throughout this program. Both procedural development as well as baseline emissions were obtained with this fuel. The fuel was obtained from American Oil Company in sealed 55-gal drums. Each drum remained sealed and intact until used and one drum was used at a time. For the lengthy procedural development tests, the tanks of the few trucks involved were drained and refilled with test fuel. The baseline data trucks operated from a 5-gal/day tank connected to the fuel pump.

V. CHASSIS DYNAMOMETER CYCLES, PROCEDURES, AND REVISIONS

A description of the chassis dynamometer cycles and their revisions is contained in this section. These cycles or revised cycles were employed to obtain correlation data as well as baseline emissions. Before discussing the revisions, it may be helpful to define certain terms used in this section.

Term	Meaning
Accel	Accelerate or acceleration
Decel	Decelerate or deceleration
WOT	Wide open throttle
PT	Part throttle
CT	Closed throttle
PTA	Part throttle acceleration
PTD	Part throttle deceleration

A. 1970 Federal Heavy-Duty Gasoline Truck Dynamometer Cycle

This cycle consists of nine modes operated at essentially a constant engine speed of 2000 rpm with a stationary engine dynamometer. The precise throttle setting and the mode-to-mode procedure is tabulated in Table 1, and the procedure is essentially the same as the California cycle[4]. A proposed Federal Cycle issued in January, 1968, included a chassis dynamometer version of the schedule, still included in the California procedure.

TABLE 1. 1970 TEST PROCEDURE, HEAVY-DUTY VEHICLES, DYNAMOMETER OPERATION CYCLE

Sequence	Mode	Manifold Vacuum, in. Hg	Time in Mode, sec	Cumulative Time, sec
1	Idle		70	70
2	Cruise	16	23	93
3	PTA	10	44	137
4	Cruise	16	23	160
5	PTD	19	17	177
6	Cruise	16	23	200
7	WOT	3	34	234
8	Cruise	16	23	257
9	CT		43	300

Engine dynamometer speed, 2000 ± 100 rpm.

An initial 5-min idle, two warm-up cycles and two hot cycles constitute a complete dynamometer run.

NOTE: The California procedure includes a provision for chassis dynamometer vehicle speed 25 ± 2 to 40 ± 2 mph to give engine speed close to 2000 rpm.

All constant-speed tests conducted by SwRI with the Class II and the 1967 stake Class IV truck were done with the motoring chassis dynamometer. By either power absorbing or motoring, the engine speed was maintained while vacuum changes were effected. For example, the 19-in. Hg vacuum setting, sequence 5, is a part-throttle deceleration which requires dynamometer motoring. The constant-speed cycle was also simulated by the tandem axle SwRI chassis dynamometer using a vehicle inertia equivalent to 25,000 lb. This adaptation was used with the Class III and first Class IV correlation trucks. In operation, this cycle is repeated four times, with an idle mode prior to the first cycle and after the fourth cycle. The heavy inertia stabilized the engine speed sufficiently for purposes of this work.

B. Experimental Truck Chassis Dynamometer Cycles

As a result of the contract PH 86-66-150, a "generalized" driving schedule was proposed for each class of vehicles. The differences in the SwRI and Ethyl dynamometers were expected to result in the need for cycle modification and adaptation. These changes were limited to those absolutely required. In the main, the resultant revised schedule, known as an "experimental cycle," was very similar to the proposed "generalized" cycle. One major departure was to change the schedules to a mph from the rpm basis. Vehicles in traffic operate on a mph basis and engine speed is incidental, though relatable, to vehicle speed. In addition, the time durations were better defined.

3. *Revisions to the Class II "Generalized" Cycle*

To gain experience and become familiar with the operation of the 1968 Chevrolet 10,000-lb GVW Class II stake truck, limited road data were obtained. The procedure was to drain and refill the vehicle tank with test fuel and load the vehicle to one-half its payload (defined as half the difference between empty and gross weight). A calibrated fifth wheel for vehicle speed, an engine rpm tachometer, and a large, 12-in.-diameter, 1/2-percent accuracy vacuum gage were installed. Also, a portable potentiometer was connected to thermocouples located in front of the grill and at the air cleaner inlet. Operating at constant vehicle/engine speeds over a north-south level road course near the Institute, engine vacuums and speeds and air temperatures were measured. These measurements, taken in both directions and averaged, are listed in Table B-1 (Appendix B) first for the road and then for the chassis dynamometer. The vehicle was then operated on the water brake dynamometer to obtain the best fit of speed vs vacuum over the range of 20 to 40 mph and the rear wheel power output recorded. From this vacuum-speed curve fitting, a satisfactory measure of road load at 30 mph could be obtained. Vehicle road-dynamometer characteristics are such that a perfect fit throughout the entire speed range was not possible. It was found that the level road load at 30 mph was 5 hp for this particular vehicle. Engine speed was 1625 with the transmission in 4th gear at an intake vacuum of 16.0 inches of mercury (Hg).

Next, the generalized Class II truck schedule, proposed in Reference 1, and included as Table B-2, was considered. As a matter of note, none of the proposed cycles from this reference were based on a specified elapsed time for the cycle or modes. For this reason, the Class II Median Truck Cycle[1], shown on Table B-4, was investigated with the SwRI Class II truck. To use the words of Reference 1, "One truck in each weight group was selected on the basis of *physical characteristics* as being most representative of that group." These median trucks did not have median emissions of the group investigated.

Operational data for the SwRI Class II Chevrolet on the SwRI chassis dynamometer with the median cycle for this class are shown in Table B-5. Comparing the results of Tables B-4 and B-5, difficulty was encountered during the mode 7 deceleration; the SwRI truck required 5 sec more to decelerate to 20 from 32 mph without applying brakes. The following part-throttle acceleration, mode 8, required 6 sec more. Last, the part-throttle acceleration, mode 11, took 11 sec more on the SwRI facility. These additional mode times combined to make the cycle approximately 20 percent longer. No brakes were used during deceleration modes, and all tests for this and other Class II vehicles were made with a simulation of 8000 lb vehicle weight.

The initial adjustment to the cycle was to change all accels in gears 2, 3, and 4 (modes 2, 3, and 4) to WOT. Normal shifting between modes was employed. These changes resulted in more repeatable operation and operation during gear shifting more normal to the usual driver habit. The level road load of 5 hp at 30 mph, preset in the SwRI water brake type dynamometer, was effective throughout the cycle. Also, the speed specifications (shown in Table B-2) of 19 mph, modes 10 and 11, and 29 mph, modes 6 through 12, were changed for the sake of simplicity to 20 and 30 mph, respectively, at the request of the Project Officer.

It was also requested that vehicle brakes be applied during the closed throttle decel modes, modes 5, 7, and 10, to determine if the times for the median truck could be obtained with the SwRI Class II truck. Although no brakes were necessary during the mode 5 decel from 32 to 27 mph, heavy application of brakes was necessary during the mode 7 decel from 32 to 20 mph. To meet the reported 5-sec median truck deceleration from 32 to 20 mph required not only heavy but immediate application of the brakes after the completion of mode 6, a WOT accel. Operation of the vehicle and application of the brakes were termed "jerky" and not realistic of normal operation. Even with the fairly heavy application of brakes, it was found that operation with the slightly revised Class II schedule still required 2 min, 13 sec to complete. Modes 8 and 11, the long accel modes, continued to consume more time than was reported for the median truck. This could be caused either by difference in dynamometers or in vehicle performance.

After some discussion with the Project Officer regarding the inability of the SwRI Class II truck to meet the reported[1] overall cycle time, it was decided to adjust the individual modes which required excessive time in order that a 2-min overall cycle time be met. The resulting experimental cycle is outlined on Table 2. Operation of the Class II Chevrolet on this schedule is reported on Table B-5 and compared to the reported median truck results as follows. The 22-sec idle, mode 1, was maintained. As previously mentioned, modes 3 and 4 were changed to WOT for simplicity and repeatability. A few seconds were gained with the WOT settings. The mode 5 median truck decel time of 6 sec was retained and treated as a maximum as it is likely that some trucks can CT decelerate in less than 6 sec from 33 to 27 mph. No change was made to the 3-sec mode 6 accel. The next decel, mode 7, was changed to 9 sec to conform to the similar mode 10 decel time of 9 sec (median truck). Brakes were only required to be applied moderately during both long decels. The 6-in. Hg manifold vacuum PT accel, mode 8, was left as-is.

TABLE 2. EXPERIMENTAL CLASS II GASOLINE TRUCK CHASSIS DYNAMOMETER CYCLE

Mode	Man. Vac, in. Hg	Gear	Vehicle Speed, mph	Time, sec Duration	Time, sec Cumulative
1. Idle		N	0	22*	22*
2. Accel	WOT	2	0–16		
3. Accel	WOT	3	15–27		
4. Accel	WOT	4	26–33		
5. Decel (With brakes if necessary)	CT	4	33–27	6 (Do not exceed)	43
6. Accel	WOT	4	27–33		
7. Decel (With brakes if necessary)	CT	4	33–20	9*	
8. Accel	6	4	20–30		
9. Cruise	Road Load	4	30		89*
10. Decel (With brakes if necessary)	CT	4	30–20	9*	98*
11. Accel	WOT	4	20–30		
12. Decel†	CT	4	30–0		120*

Repeat above for total of four cycles, total time of 480 sec.

*Time specified must be met.
†Declutch at 120 sec and allow engine to idle (start time for next cycle, mode 1 - use brakes to slow to stop).

In conversations with the Project Officer, it was agreed that a specified time should be met following the first cruise mode. To do this, the actual times required for modes 1 through 8, described above, were obtained with the SwRI Class II 1968 Chevrolet. These times were summed and the 22-sec cruise at 30 mph, mode 9, added to this sum to give a total cumulative time at the end of mode 9 of 1 min, 29 sec. The mode 9 cruise serves to absorb any excess cumulative time which might occur during the first eight modes for a particular truck which cannot perform the same as the SwRI Class II truck.

Continuing with the description of the modifications made and referring to Table B-5, the mode 10 extended decel from 30 to 20 mph was unchanged timewise. The 8-in. Hg vacuum accel from 20 to 30 mph was changed to WOT to approach the 5-sec duration reported for the median truck. The SwRI Class II truck, operated at WOT, required 8 sec to accel from 20 to 30 mph, for a total cumulative time at the end of mode 11 of 1:46. To meet the objective of a 2-min overall cycle, the mode 12 CT decel was reached using a 14-sec duration. This is 1 sec less than that reported for the median truck (Table B-3).

It is possible that some trucks may require more than 8 sec during the WOT accel, mode 11, giving a shorter mode 12 deceleration for an overall cycle of 2 min. This overall time is 6 sec longer than the cumulative time reported for the median truck. Since the cycle was repeated four times, the operation was simplified by making each cycle an even number of minutes. Mode 12 deceleration was CT until the 2-min cumulative time was reached. At this point, the vehicle was declutched, and the engine allowed to idle. Time for the next 22-sec idle mode, mode 1, began when the vehicle was declutched. With the vehicle declutched, brakes were applied to bring the rear wheels to rest in preparation for the accel through the gears.

The results of operation of a Class II truck with a smaller displacement engine than the 250-CID, 1968 Chevrolet stake truck are listed in Table B-6. The vehicle studied was a 1963 Ford, 223-CID, 10,000-lb

GVW stake truck. Both previously reported 1968 Chevrolet 250CID and 1963 Ford 223CID with experimental cycle data are listed to permit direct comparison of mode durations and cumulative times. The 1967 Ford stake truck powered by a smaller 223-CID, six-cylinder engine was judged an "underpowered" truck as far as operation on the cycle was concerned.

For the particular driveline arrangement, rear wheel response to a change in throttle setting of this vehicle under level road conditions was definitely slower than some other Class II vehicles.

According to Table B-6, all accel modes required more time to reach the given speed increase at the specified throttle setting. The total increase in time preceding the cruise, mode 9, was 12 sec. This time was made up by decreasing the length of the cruise mode. An additional 6 sec was made up during the CT decel, mode 12. In summary, the modifications made to the proposed Class II schedule appear to allow operation of both a well-performing as well as an "underpowered" vehicle without major changes. The reduction in cruise time, mode 7, was of concern as was the reduction in the last decel.

2. *Revisions to the Class III "Generalized" Cycle*

Initial studies of the Class III correlation vehicle, a 1965 C-60 Chevrolet van, included limited road operation similar to the Class II truck. Following the procedure previously described, vehicle engine road characteristics such as mph, rpm, and manifold vacuum were obtained and then reproduced on the chassis dynamometer to obtain the best road power curve. The results of both road and dynamometer operation are listed in Table B-7. The level road load at 30 mph was 18 hp for this particular vehicle. Engine speed was 1950 rpm at 15 in. Hg vacuum.

The generalized Class III truck cycle from Reference 1 is tabulated in Table B-8. As with each of the three generalized cycles, the median truck cycle times, shown in Table B-9, were used as much as possible during cycle study and adjustment. After repeated attempts to run the Class III median truck cycle, it was decided that certain adjustments had to be made to operate the cycle on the SwRI dynamometer with a fixed 16,000-lb inertia equivalent. Particularly difficult to operate was the 6-sec accel in 4th gear from 18 to 35 mph. This, as well as 0 to 9-mph accel in 2nd gear, was impossible to achieve in the time duration specified. It was also found that when operating at the cruise conditions specified in 5th gear of 12-1/2 in. of Hg intake vacuum at 25 mph and 11-1/2 in. of Hg at 28 mph that the operation of the vehicle seemed to be on a "steep" hill. This was borne out by the level road vacuum shown in Table B-7. For example, at the 25-mph cruise, an intake vacuum of 17 in. of Hg was recorded versus the 12-1/2 in. settings shown in Table B-9. Because of the difficulties found during the accel from gears 2 to 4, it was decided to redistribute the 31 sec allocated for the accel in 2nd, 3rd, and 4th and to determine if the vehicle under WOT conditions could reach 35 mph within this time requirement. By changing the 0 to 9-mph duration from 3 to 4 sec, the 9 to 18-mph acceleration to a 6-sec duration, and allocating the remaining 20 sec of the overall 30-sec requirement to the 18 to 35-mph accel in 4th gear, it was found that this particular vehicle could reach the required 35 mph in 31 sec. It should be noted that shifting gears had to be somewhat faster than is normally the practice on the road. Table B-10 lists the operating times with the median cycle but at road load and other initial adjustments mentioned above.

An experimental Class III cycle, Table 3, evolved after consultation with the Technical Officer. This cycle was tabulated such that the initial accel modes could vary in elapsed time. The first time requirement was specified at the end of the first cruise mode so that cruise mode elapsed time was longer for "overpowered" trucks and less for "underpowered" trucks. The preceding PT accel mode time was specified at 6 seconds. Again, the particular truck determines the exact PT vacuum setting. The total time of the cycle was also determined such that the cycle was "tied down." Normal shifting and level road load setting were incorporated in this modified cycle.

Shown on Table B-11 are the operating data obtained with the experimental schedule of test Table 3 for the 1965 Chevrolet van. The times specified could be met by satisfactory driving procedure and the shifting points were natural.

TABLE 3. EXPERIMENTAL CLASS III GASOLINE TRUCK CHASSIS DYNAMOMETER CYCLE

Mode	Man. Vac, in. Hg	Gear	Vehicle Speed, mph	Time, sec	
				Duration	Cumulative
1. Idle		N	0	20*	20*
2. Accel	WOT	2	0-12		
3. Accel	WOT	3	12-24		
4. Accel	WOT	4	24-35	30	50
5. Decel (With brakes if necessary)	CT	4	35-25	10 (Do not exceed)	60
6. Cruise	Road Load	4	25		72*
7. Accel	PT	4	25-28	6*	78*
8. Cruise	Road Load	4	28	12*	90*
9. Decel†	CT	4	28-0	16*	106*

Repeat above for total of four cycles, total time of 424 sec.

*Time specified must be met.
†Declutch at 106 sec and allow engine to idle (start time for next cycle, mode 1 - use brakes to slow to stop).

3. *Revisions to the Class IV "Generalized" Cycle*

Two vehicles were employed to determine the revisions necessary to the "generalized" Class IV cycle. The vehicles, described in a previous section, were a 1966 IH stake truck and a 1967 Chevrolet stake truck. Initial road and dynamometer data for these vehicles are listed on Tables B-12 and B-13. From this, a level road load at 30 mph in 4th gear was established. For the IH stake, it was 14 rear-wheel hp at a 16-in. Hg manifold vacuum at a 2350-rpm engine speed. For the Chevrolet, it was 12 hp at 16 in. Hg and 2650 rpm. The "generalized" Class IV truck cycle, proposed in Reference 1 and described in Table B-14, was then studied for its operability on the SwRI dynamometer. For guidance, the median Class IV truck results from Reference 1 listed in Table B-15 were used.

Attempts were made to run the IH stake with the median cycle. Although the difficulties encountered with this cycle were not as great as those experienced with the Class II and III cycles, some adjustments had to be made in order to meet the durations specified during the accel through gears. It was found that the accel in 4th gear from 18 to 35 mph was impossible to achieve with 16,000 lb vehicle inertia simulation in a 9-sec period. It was felt that the 18 to 32-mph accel in 4th was in conflict with the 28 to 35-mph accel in 5th gear. To operate this portion of the cycle as specified in Table B-15 required an excessive amount of "droop" during gear changing and an excessive amount of time lost while the vehicle speed decreased from 20 back to 18 mph during the shift from 3rd to 4th gear and especially during the shift from 4th into 5th where a droop from 32 to 28 mph is indicated. To adequately accelerate through gears similar to the method used in normal vehicle operation in going from 0 to 35 mph, it was decided to try and meet the time durations specified for accel in each gear by using a WOT setting and normal shifting to insure repeatable operation.

Both vehicles were then operated with the adjustments listed above. The results are shown on Tables B-16 and B-17 for the IH and Chevrolet trucks. Operation of both vehicles was measurably improved over that with the "generalized" cycle but was still less than satisfactory.

As a result of these revisions, an experimental cycle was prepared and is described in text Table 4. Results from operating the two Class IV vehicles on this schedule are listed in Tables B-18 and B-19. The 1967 Chevrolet stake truck was able to operate this cycle with ease and the IH stake operation was satisfactory.

In summary of this section, necessary revisions to the "generalized" cycles proposed in Reference 1 were made to enable these procedures to be utilized on the SwRI dynamometer. These revisions, made with the advice and consent of the Project Officer, "tied-down" the cycle to a specified time duration and were

TABLE 4 EXPERIMENTAL CLASS IV GASOLINE TRUCK CHASSIS DYNAMOMETER CYCLE

Mode	Man. Vac, in. Hg	Gear	Vehicle Speed, mph	Time, sec Duration	Time, sec Cumulative
1. Idle		N	0	27*	27*
2. Accel	WOT	2	0 - 11	—	—
3. Accel	WOT	3	11 - 20	—	—
4. Accel	WOT	4	20 - 31	—	—
5. Accel	WOT	5	31 - 35	39	66
6. Decel (With brakes if necessary)	CT	5	35 - 21	13 (Do not exceed)	79
7. Cruise	Road Load	5	21	28	107*
8. Accel	PT	5	21 - 24	19*	126*
9. Cruise	Road Load	5	24	28*	154*
10. Decel	PT	5	24 - 21	6*	160*
11. Cruise	Road Load	5	21	28*	188*
12. Decel†	CT	5	21 - 0	12*	200*

Repeat above for a total of two cycles, total time of 400 sec.

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* Time specified must be met.

† Declutch at 200 sec and allow engine to idle (start time for next cycle, mode 1 - use brakes to stop).

changed to level road load vehicle operation. Accel through the gears was standardized to WOT for repeatability of operation. Only minor adjustments were made to the Class IV schedule while greater revision was found necessary for the Class III and II cycles. Large changes in operational philosophy time allotments to various modes such as cruise, accel, decel, idle, etc., were *not* made. Overall Reference 1 median truck cycle times were maintained. In short, only those changes absolutely needed to enable the cycle to be used with a number of different vehicles were affected.

VI. CORRELATION EMISSION TEST RESULTS

A. Comparison of Experimental Cycle Results with DLA Road Course Data

Discussed in this section are the results of experiments to determine the level of correlation between SwRI and those reported in Reference 1. For this purpose, the SwRI chassis dynamometer results, using experimental cycles, are compared to the Detroit-Los Angeles (DLA) road course data listed in Reference 1. Once this correlation was determined, the experimental cycles were used to investigate the extent of correlation between the servoproportional and constant volume samplers. These two samplers, operated simultaneously, were employed during experiments involving several different road load conditions. Next, a series of runs was made using the proposed 1970 Federal Heavy-Duty Truck Cycle.

In the three discussion areas of this section, the Class II truck results are presented first. The single Class III truck results are presented second, followed by the two Class IV results. The data summarized in the tables of this section are usually the average of a test series involving four identical runs. The Class II, III, and IV run results are included in Appendix C, and provide supporting data as well as an indication of run-to-run repeatability and variability. The results are presented in tabular form and in order of their discussion in the text and follow the chronological order of: first, operation with experimental cycles using the servoproportional sampler for comparison to previous work; second, correlation of constant volume results with servoproportional under the same conditions; third, continuous and constant volume sampling and analysis results with the 1970 Federal Heavy-Duty Truck Cycle.

Table 5 is a comparison of the exhaust emission values of three Chevrolet trucks powered by 250-CID inline, six-cylinder engines. Hydrocarbon emission results are listed as analyzed by NDIR and FIA on a pounds of carbon per mile driven or mass basis. Similarly, NO_x as pounds of NO_2 per mile, CO as pounds of CO per mile, and CO_2 as pounds of CO_2 per mile are listed. Two operating parameters of interest, average air/fuel ratio and engine exhaust flow rate in standard cubic feet (SCF) per mile, are shown. The NDIR unburned hydrocarbon values are, characteristically, less than the FIA results such that the FIA to NDIR ratio is an average of 1.8.

The emission data listed in the top portion of this table were reported in Reference 1. The lower portions of the table are emission results for the 1968 Chevrolet 10,000-lb GVW stake truck operated by SwRI.

Since the objective of the experimental cycle is to produce emissions which represent truck emissions in service, the original DLA road course emissions results are used for comparison purposes. A simple "comparison ratio" is used to indicate the magnitude of difference between the DLA and chassis dynamometer emissions data. Values greater than 1.0 indicate that dynamometer cycle data are higher than road course data and values less than 1.0 indicate the opposite trend. A value of 1.0 indicates perfect correlation.

The first set of comparison ratios, from Reference 1, indicates the correlation between the 1966 Chevrolet van DLA road course and chassis dynamometer emission data. As shown, the hydrocarbons, NO_x, CO_2, and engine airflow were somewhat lower than desired. This is indicated by an overall average comparison ratio of 0.86. The agreement between the dynamometer cycle and the DLA emissions, from Reference 1, for the 1966 Chevrolet pickup were better as indicated by the total comparison ratio average of 0.98. The hydrocarbon emissions during the dynamometer cycle were low relative to the road course data; the comparison ratio was 0.82.

Because of the time lapse, a previously used Class II truck was not available to SwRI for experimentation. Therefore, the Reference 1 DLA road course emissions data selected for comparison were the 1966 Chevrolet pickup data. Its N/V ratio was closer to the SwRI 1968 Chevrolet stake. The 1966 pickup also had less miles traveled than the 1966 van and corresponds closer to the relatively new 1968 stake truck with an odometer reading of 6000 miles. A much better correlation between original DLA and chassis dynamometer data was reported with the 1966 Chevrolet pickup.

A comparison of the 1966 pickup DLA road course emissions to the results obtained with the SwRI 1968 Chevrolet operated under the Table 3 dynamometer schedule with a level road load setting is shown in

TABLE 5. COMPARISON OF CLASS II EXPERIMENTAL CYCLE
EMISSIONS TO ROAD COURSE (DLA) EMISSIONS

Vehicle tested	Test Schedule, See Table	Cycle Operated	Cycle Loading	Sampling System	HCDA, lb/mi	HCFIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel Avg	Exhaust Flow, SCF/mi	N/V Ratio	GVW
Ethyl Road and Chassis Results for Two Different Chev 250-CID Trucks Per Final Report (2-Run Average)													
66 Chev Van	–	DLA	Road	Servo	0.0322	0.0525	0.0120	0.3034	1.259	12.78	91.4	57.3	10,000
"	2	Ch. Dyn.	13.9 hp*		0.0266	0.0453	0.0082	0.3245	1.066	12.28	79.6	57.3	10,000
			Comparison Ratio		0.83	0.86	0.65	1.07	0.85	0.96	0.87		
66 Chev Pickup	–	DLA	Road	Servo	0.0236	0.0565	0.0146	0.1761	1.252	13.22	85.0	56.0	7,500
"	2	Ch. Dyn.	13.9 hp*		0.0193	0.0298	0.0207	0.1450	1.249	13.36	86.3	56.0	7,500
			Comparison Ratio		0.82	0.53	1.42	0.82	1.00	1.01	1.01		
SwRI Chassis Dynamometer Results for One Chev 250-CID Truck VS Ethyl Road Data, 1966 Chev Pickup (SwRI Data Are Averages of Seven Runs)													
66 Chev Pickup	–	DLA	Road	Servo	0.0236	0.0565	0.0146	0.1761	1.252	13.22	85.0	56.0	7,500
69 Chev Stake†	7	Ch. Dyn.	Road Load‡		0.0257	0.0682	0.0133	0.1827	1.133	12.94	89.9	52.4	10,000
			Comparison Ratio		1.09	1.20	0.95	1.04	0.92	0.98	1.06		
66 Chev Pickup	–	DLA	Road	Servo	0.0236	0.0565	0.0146	0.1761	1.252	13.22	85.0	56.0	7,500
69 Chev Stake†	7	Ch. Dyn.	Road Load‡	Const. Vol.	0.0232	0.0982	0.0178	0.2295	1.304	–	104.3	52.4	10,000
			Comparison Ratio		0.98	1.73	1.22	1.30	1.04	–	1.23		

*Vacuum not reported. For medium truck, the cruise load at 25 mph was 16 in. Hg intake vacuum.
†Support data presented in Table C-1 of Appendix C.
‡Level road load at 30 mph was 5 hp at 16 in Hg vacuum in 4th gear with one-half payload weight.

in the lower portion of Table 5. An overall comparison ratio of 1.01 is shown between the road course and experimental cycle.

In review, the experimental schedule of Table 2 appears to satisfactorily reflect the driving modes in Reference 1. Operation of the SwRI vehicle on this schedule resulted in airflow which compared favorably with both previously operated vehicles with the same make and size but *not* the identical engine.

A summary of the SwRI and Reference 1 results for the Class III Chevrolet van is presented in Table 6. Listed first is the road course DLA results, followed by the chassis dynamometer data taken from Reference 1. Next, the SwRI chassis dynamometer results are presented for three load conditions of level road (18 hp), "slight uphill" (30 hp), and "uphill" (43 hp). Comparison ratios are listed below each mass emission value to indicate the degree of agreement with the DLA road course.

TABLE 6. COMPARISON OF CLASS III EXPERIMENTAL CYCLE EMISSIONS TO ROAD COURSE (DLA) EMISSIONS

Vehicle: 1965 Chevrolet Van
Engine: 292 cu in., six-cylinder

Sampler: Servoproportional
Fuel: Indolene

Cycle	Load Condition	Data Source	HC/IR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel Avg	Exhaust Flow, SCF/mi
DLA	Road	PHS	0.0322	0.0571	0.0188	0.441	1.795	12.65	131.0
Ch. Dyn.		PHS	0.0297	0.0515	0.0285	0.417	1.956	12.76	142.5
	Comparison Ratio		0.92	0.90	1.52	0.95	1.09	1.01	1.09
Ch. Dyn.*	Road (18 hp)	SwRI	0.0269	0.0455	0.0177	0.397	1.793	12.90	136.0
	Comparison Ratio		0.84	0.80	0.94	0.90	1.00	1.02	1.04
Ch. Dyn.*	Slight Uphill (30 hp)	SwRI	0.0257	0.0457	0.0280	0.424	2.06	12.75	155.5
	Comparison Ratio		0.80	0.80	1.48	0.96	1.15	1.01	1.19
Ch. Dyn.*	Uphill (42 hp)	SwRI	0.0277	0.0506	0.0243	0.647	2.40	12.63	189.0
	Comparison Ratio		0.86	0.88	1.29	1.46	1.34	1.00	1.44

*Supporting data presented in Table 8 of Appendix C.

In general, there is good agreement between the level road experimental cycle (SwRI) and the DLA data. The comparison ratio ranges from a minimum of 0.80 to a maximum of 1.04, with an overall seven-variable average of 0.95. However, the HC, CO, and NO_x data—with comparison ratios less than one—indicate that this particular Class III truck did not produce as much HC, CO, and NO_x under the experimental cycle as on that reported on the DLA course. Airflow through the engine was slightly greater than the road airflow.

In an attempt to bring the HC and CO into closer agreement with the DLA road data, two higher load conditions were arbitrarily selected representing a vehicle operating under a "slight uphill" and an "uphill condition." By operating at a slight uphill condition, 30 hp preset into the water brake dynamometer at 30 mph and retained, no change in HC was obtained, although NO_x and CO were increased, particularly NO_x with a comparison ratio of 1.48 instead of 0.94 at level road load. A wider spread of comparison ratios appeared with a maximum of 1.48 and a minimum of 0.80, although the overall average of 1.06 does indicate a good comparison.

Further investigation of the effect of load involved an uphill (road load plus 24 hp) condition. The emission ratio comparison showed all emissions except HC to be in excess of the road data with the overall average comparison ratio of 1.18, with a maximum of 1.46 and a minimum of 0.86. However, the road operation air/fuel ratio was equalled, and the increase to an apparent overall richer operation from the level road load was signaled by the increase in HC, CO, and A/F data and the decrease in the NO_x emissions.

Shown in Table 7 are the Class IV, 1965 IH stake truck DLA road and chassis dynamometer results reported in Reference 1 and the SwRI chassis dynamometer results. As in Table 6, the original data from Reference 1 are listed first for the DLA and then the chassis dynamometer. The reported comparison ratios range from a maximum of 2.05 for NO_x emissions to a minimum of 0.82 for CO emissions with an overall

TABLE 7. COMPARISON OF CLASS IV EXPERIMENTAL CYCLE EMISSIONS TO ROAD COURSE (DLA) EMISSIONS

Vehicle: 1966 IHC Stake
Engine: 345-cu in., V-8

Sampler: Servoproportional
Fuel: Indolene

Cycle	Load Condition	Data Source	HC/IR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel Avg	Exhaust Flow, SCF/mi
DLA	Road	PHS	0.0261	0.0483	0.0158	0.325	1.74	12.88	128.5
Ch. Dyn.		PHS	0.0228	0.0436	0.0325	0.266	2.86	13.37	163.5
	Comparison Ratio		0.88	0.90	2.06	0.82	1.65	1.04	1.26
Ch. Dyn.*	Road (14 hp)	SwRI	0.0236	0.0489	0.0127	0.421	2.11	12.79	142.7
	Comparison Ratio		0.91	1.01	0.805	1.29	1.21	0.99	1.11
Ch. Dyn.†	Slight Uphill (19 hp)	SwRI	0.0236	0.0469	0.0123	0.450	2.19	13.00	160.0
	Comparison Ratio		0.91	0.97	0.778	1.38	1.26	1.01	1.24

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*Supporting data presented in Table 15 of Appendix C.

†This set of run data was forwarded to PHS in a preliminary rough pencilled table dated September 14, 1967, as road load data. The original misinterpretation was discovered by the high engine airflow rate, and recheck of original data confirmed the error.

average of 1.32. The overall set of emissions data was adjudged to lack the desired degree of correlation with the road course. The main reason given in Reference 1 was that the vehicle was "underpowered."

Next, the data acquired with the experimental twelve-mode cycle are tabulated for a level road condition. In general, there is excellent agreement with the DLA data as exemplified by the comparison ratio maximum of 1.29 for CO and minimum of 0.805 for NO_x with an overall average of 1.04. The exhaust rate during this cycle is at a more acceptable ratio of 1.11 as opposed to the ratio of 1.26 computed for the Reference 1 data.

The last set of emissions presented in Table 7 were with the experimental twelve-mode cycle with a slightly higher than level road load preset in the water brake. At this "slight uphill" condition, a good correlation also is indicated by the overall ratio of 1.08. The increase in loading with the experimental cycle is readily indicated by the increase in airflow rate and carbon dioxide content.

In order to further investigate, the level of correlation with previous data in the Class IV weight range, a 1967 Chevrolet C-60H stake truck powered by a 1966, 366-CID, V-8 engine was obtained from General Motors Research. Although the engine was installed in a different chassis and drive train in tests at SwRI than previous PHS sponsored work, a good correlation was found as shown in Table 8. As in Tables 6 and 7, the original DLA road data are presented first, followed by results reported in Reference 1. A review of the comparison ratios indicates excellent agreement with the DLA data. Only the minimum ratio of 0.89 for CO can be pointed out as low relative to the road data.

The SwRI level road load data are tabulated next on Table 8. The HC and A/F results are the only data that satisfactorily correlate with the DLA road course data. The NO_x, CO, CO_2, and exhaust flow appear to be at about one-third the concentration of the corresponding road data indicating a need for more load during the cycle. This trend was not indicated with the first Class IV truck. As a result of this apparent lack of overall correlation, a study was made to determine the effect of load and consequent correlation with the road course data. A number of road load conditions were included and are listed by increasing power setting from the level road load of 12 hp to an "uphill" condition of 44 hp with intermediate settings at 22 hp ("slight" uphill) and 34 hp ("moderate" uphill). All of these power settings were preset in the water brake dynamometer at 30 mph and retained during the cycle operation. From the four road power conditions listed, the uphill load condition results at the bottom of Table 8 correlated the best with the DLA road data.

In brief, correlation with the road course (DLA) was established at an "uphill" road condition for the 1967 Chevrolet stake truck. This was not the case for the other Class IV truck where the correlation was established at a level road condition. One possible explanation for the lack of correlation at level road load with the 1967 Chevrolet stake truck might be possible changes in adjustment or other engine modifications

TABLE 8. COMPARISON OF CLASS IV EXPERIMENTAL CYCLE EMISSIONS TO ROAD COURSE (DLA) EMISSIONS

Vehicle: 1967 Chevrolet Stake
Engine: 366-cu in., V 8

Sampler: Servoproportional
Fuel: Indolene

Cycle	Load Condition	Data Source	HC/HR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel Avg	Exhaust Flow, SCF/mi
DLA	Road	PHS	0.0197	0.0368	0.0480	0.2010	3.026	13.96	197.55
Ch. Dyn.		PHS	0.0201	0.0374	0.0446	0.1788	2.783	13.73	186.1
	Comparison Ratio		1.02	1.015	0.93	0.89	0.92	0.983	0.94
Ch. Dyn.*	Road (12 hp)	SwRI	0.0186	0.0348	0.0252	0.1390	2.115	13.68	147.5
	Comparison Ratio		0.945	0.945	0.525	0.69	0.70	0.98	0.75
Ch. Dyn.*	Slight Uphill (22 hp)	SwRI	0.0189	0.0333	0.0308	0.162	2.225	13.64	155.5
	Comparison Ratio		0.96	0.905	0.64	0.81	0.735	0.98	0.79
Ch. Dyn.*	Moderate Uphill (34 hp)	SwRI	0.0174	0.0315	0.0365	0.191	2.39	13.61	171.0
	Comparison Ratio		0.88	0.86	0.76	0.96	0.79	0.98	0.86
Ch. Dyn.*	Uphill (44 hp)	SwRI	0.0173	0.0324	0.0441	0.218	2.66	13.61	193.0
	Comparison Ratio		0.875	0.88	0.92	1.085	0.87	0.98	0.98

*Supporting data presented in Table 21 of Appendix C.

in carburetion and ignition between the time the original measurements were made and the time the vehicle was obtained for use in the SwRI program.

In summary, satisfactory correlation was demonstrated between the DLA road course results and the experimental cycle data for the Class II and Class III vehicles and the Class IV 1966 IH stake truck at level road load power settings. The other Class IV vehicle correlated well with the previously obtained road data at an "uphill" road load power setting. Using the experimental cycles, a satisfactory level of agreement and correlation to that reported in Reference 1 was obtained.

B. Correlation of Constant Volume with Servoproportional Sampler Results

The next objective was to relate the results of constant volume and servoproportional samples. The first vehicle studied was the 1968 Class II Chevrolet stake. Exhaust was obtained simultaneously by both sampling systems. These results are tabulated in summary form in Table 9 and indicate the maximum, minimum, and average based on a minimum of four replicate runs. The correlation was made with the experimental twelve-mode cycle, Table 2, at road load conditions and two uphill loading conditions.

The trends of agreement for the constant volume and servoproportional samplers were a bit erratic, but the specific corresponding values did not vary greatly. The following discussion will trace the particular emission results through the various preset loads. The road load hydrocarbon values essentially were equivalent, shown by comparison values of 1.0 and 0.95. The slight uphill hydrocarbon results by the constant volume sampler were about 10 percent greater than the servoproportional results. This trend, however, was reversed with the uphill condition. The oxides of nitrogen values showed the greatest differences. The trend of higher NO_x values with the constant volume sampler was not the same as that found in later tests. The constant volume NO_x results for the Class III and IV correlation trucks were lower than those found with the servoproportional sampler. No explanation can be made for this difference.

The CO and CO_2 mass emissions with the constant volume sampler were also slightly higher than the servoproportional sampler results. The CO mass emissions measured by the constant volume technique were slightly higher than the servoproportional sampler during the three load conditions. The CO_2 emissions were also slightly higher with the constant volume sampler measurement technique.

To measure exhaust flow rate using the constant volume sampler, a continuous trace of the raw exhaust CO_2 concentration was monitored and integrated. With the known ratio of raw exhaust CO_2 to diluted sample CO_2 and the known volume of total sampler flow, the average exhaust gas flow rate can

TABLE 9. CORRELATION OF EMISSIONS BY SERVO AND CONSTANT VOLUME METHODS, CLASS II EXPERIMENTAL CYCLE*

Vehicle: 1968 Chevrolet Stake
Engine: 250 CID, I-6

Fuel: Indolene
Cycle: Experiment Twelve-Mode

Run Condition	Vehicle Power Obs. hp	Proportional Sampling Method		NDIR UBHC, lb/mi	FIA UBHC, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, Avg	Air/Fuel SCF/mi	Exhaust Flow,
Level Road Load	5	Servo	Max	0.0235	0.0458	0.0148	0.2185	1.209	13.05	92.4
			Min	0.0185	0.0373	0.0117	0.1565	1.045	12.65	81.1
			Avg	0.0207	0.0403	0.0133	0.1827	1.133	12.94	89.8
		Constant Volume	Max	0.0249	0.0419	0.0203	0.2355	1.380		112.5
			Min	0.0173	0.0360	0.0164	0.2180	1.130		94.1
			Avg	0.0203	0.0382	0.0192	0.2275	1.284		106.3
		Comparison Ratio		0.98	0.96	1.48	1.29	1.14		1.19
Slight Uphill Road Load	14	Servo	Max	0.0171	0.0357	0.0161	0.216	1.603	13.35	111.0
			Min	0.0161	0.0347	0.0149	0.202	1.440	12.05	109.5
			Avg	0.0164	0.0350	0.0156	0.211	1.491	13.20	110.6
		Constant Volume	Max	0.0194	0.0391	0.0220	0.254	1.470		122.0
			Min	0.0179	0.0368	0.0152	0.238	1.460		115.0
			Avg	0.0186	0.0384	0.0169	0.250	1.470		119.3
		Comparison Ratio		1.13	1.10	1.08	1.18	0.99		1.08
Uphill Road Load	18	Servo	Max	0.0228	0.0433	0.0213	0.268	1.610	13.55	115.0
			Min	0.0199	0.0396	0.0172	0.241	1.335	13.40	113.0
			Avg	0.0215	0.0420	0.0190	0.250	1.483	13.50	114.1
		Constant Volume	Max	0.0200	0.0394	0.0273	0.310	1.700		143.5
			Min	0.0182	0.0377	0.0223	0.296	1.665		136.4
			Avg	0.0190	0.0386	0.0245	0.304	1.683		139.2
		Comparison Ratio		0.88	0.92	1.29	1.21	1.13		1.22

*Supporting run data shown on Tables 3 through 4 of Appendix C.

be calculated. This particular method appears to give higher exhaust flow rates than using the more exact servo proportional sampler exhaust airflow measurement system (see results in Table 9).

An analysis of the emission trends using either or both sampling systems as a function of chassis dynamometer loading can be made from Figure 9. This figure depicts the HC, CO, NO_x, CO_2 results listed in Table 9. Before discussing these trends, it should be noted that the effect of load is of importance mainly during the constant speed cruise portions of the cycle.

The emission trends of both sampling systems "tracked" well for the three run conditions. One indicator of increasing load was the engine exhaust flow which increased as the load increased.

The two sampling techniques showed an almost linear CO increase with load while the CO_2 leveled off at the slight uphill and uphill load condition. The hydrocarbon emissions measured by the NDIR instrument "tracked" well and went through a slight minimum at the slight uphill condition. The constant volume FIA results were essentially unchanged by loading, while the servoproportional results go through a minimum at the slight uphill condition. Oxides of nitrogen also show contradictory trends. The constant volume NO_x results go through a minimum at the slight uphill condition, while the servoproportional results increase linearly with load. In summary, it appears that the PHS servoproportional and constant volume methods result in fairly similar emissions.

The Class III results are tabulated in summary form in Table 10 and indicate the maximum, minimum, and average based on a minimum of four replicate runs. This vehicle was operated on the nine-mode Class III

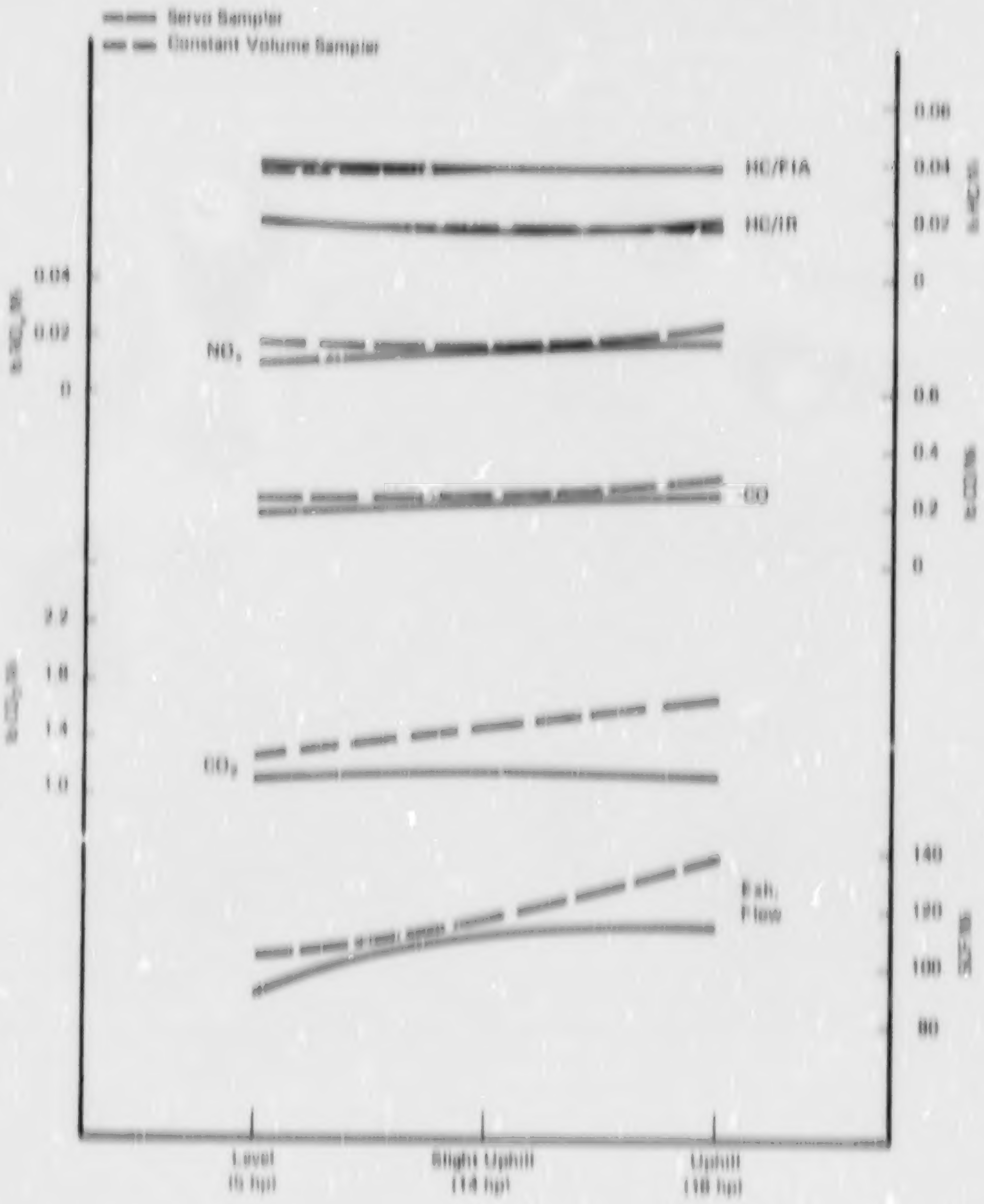

FIGURE 9. EFFECT OF ROAD LOAD ON 1968 STAKE TRUCK EMISSIONS—CLASS II EXPERIMENTAL CYCLE

TABLE 10. CORRELATION OF EMISSIONS BY SERVO AND CONSTANT VOLUME METHODS, CLASS III EXPERIMENTAL CYCLE*

Vehicle: 1965 Van, 19,500 GVW
Engine: 292 cu in., six-cylinder

Fuel: Indolene
Cycle: See Table 3

Run Condition	Vehicle Power Obs, hp	Proportional Sampling Method		NDIR UBHC, lb/mi	FIA UBHC, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel Avg	Exhaust Flow SCF/mi
Level Road Load	18	Servo	Max	0.0264	0.0498	0.0244	0.384	1.830	12.98	139.0
			Min	0.0240	0.0396	0.0213	0.334	1.700	12.83	130.7
			Avg	0.0253	0.0468	0.0227	0.362	1.768	12.91	135.8
		Constant Volume	Max	0.0312	0.0664	0.0255	0.472	1.815		
			Min	0.0267	0.0449	0.0133	0.346	1.742		
			Avg	0.0293	0.0602	0.0180	0.382	1.794		
		Comparison Ratio		1.15	1.28	0.81	1.06	1.00		
Slight Uphill Road Load	30	Servo	Max	0.0271	0.0505	0.0286	0.498	2.075	12.98	152.0
			Min	0.0241	0.0434	0.0218	0.428	1.900	12.73	144.5
			Avg	0.0260	0.0482	0.0238	0.457	1.964	12.81	148.5
		Constant Volume	Max	0.0310	0.0657	0.0233	0.496	2.197		
			Min	0.0260	0.0635	0.0176	0.439	2.050		
			Avg	0.0288	0.0640	0.0205	0.466	2.121		
		Comparison Ratio		1.11	1.34	0.86	1.02	1.07		
Uphill Road Load	44	Servo	Max	0.0275	0.0601	0.0193	0.701	2.26	12.55	184.0
			Min	0.0258	0.0575	0.0177	0.607	2.21	12.38	178.0
			Avg	0.0266	0.0586	0.0182	0.658	2.23	12.49	180.4
		Constant Volume	Max	0.0324	0.0724	0.0138	0.687	2.30		
			Min	0.0311	0.0600	0.0077	0.588	2.15		
			Avg	0.0315	0.0674	0.0129	0.656	2.21		
		Comparison Ratio		1.18	1.15	0.71	1.0	0.99		

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*Supporting data shown on Tables 9, 10, and 11 of Appendix C.

experimental cycle shown in Table 3 and simultaneous proportional samples were obtained by the servo and constant volume methods. These experiments included level road and two uphill conditions to investigate the degree of agreement of the two proportional sampling techniques.

The data summarized in Table 10 indicate that the constant volume sampler results were higher than those obtained by the servo sampler under all conditions and for all emissions except NO_x. Excellent agreement was indicated for CO, comparison ratios from 1.0 to 1.06, and for CO_2 with ratios from 0.99 to 1.07. The poorest agreement was in the hydrocarbon data which were consistently higher and in the NO_x data which were lower with the constant volume sampler. Emissions in Table 10 are plotted in Figure 10. The hydrocarbon, CO, CO_2, and NO_x data show the effect of a change in road load for the nine-mode experimental Class III cycle. Except for the FIA, HC and CO_2 results, exhaust analyses of the samples from the two systems seemed to "track" and agree well as the load was varied.

Two different Class IV vehicles were investigated using the twelve-mode experimental cycle described in Table 4. Two operating conditions were studied in detail for the 1966 IH Class IV truck; namely, a level load (14 hp) and an uphill road load (19 hp). Shown on Table 11 are the summarized results for this vehicle using the same twelve-mode experimental cycle. All exhaust emissions from this vehicle were higher with the constant volume technique than with the servo sampler. The overall comparison ratio ranged from a minimum of 1.01 to a maximum of 1.13, with an overall average of 1.06 indicating a very close agreement between the constant volume and servoproportional sampling techniques. Although only two load conditions were investigated, the general trend in emissions may be commented on. First, hydrocarbon mass emissions by both

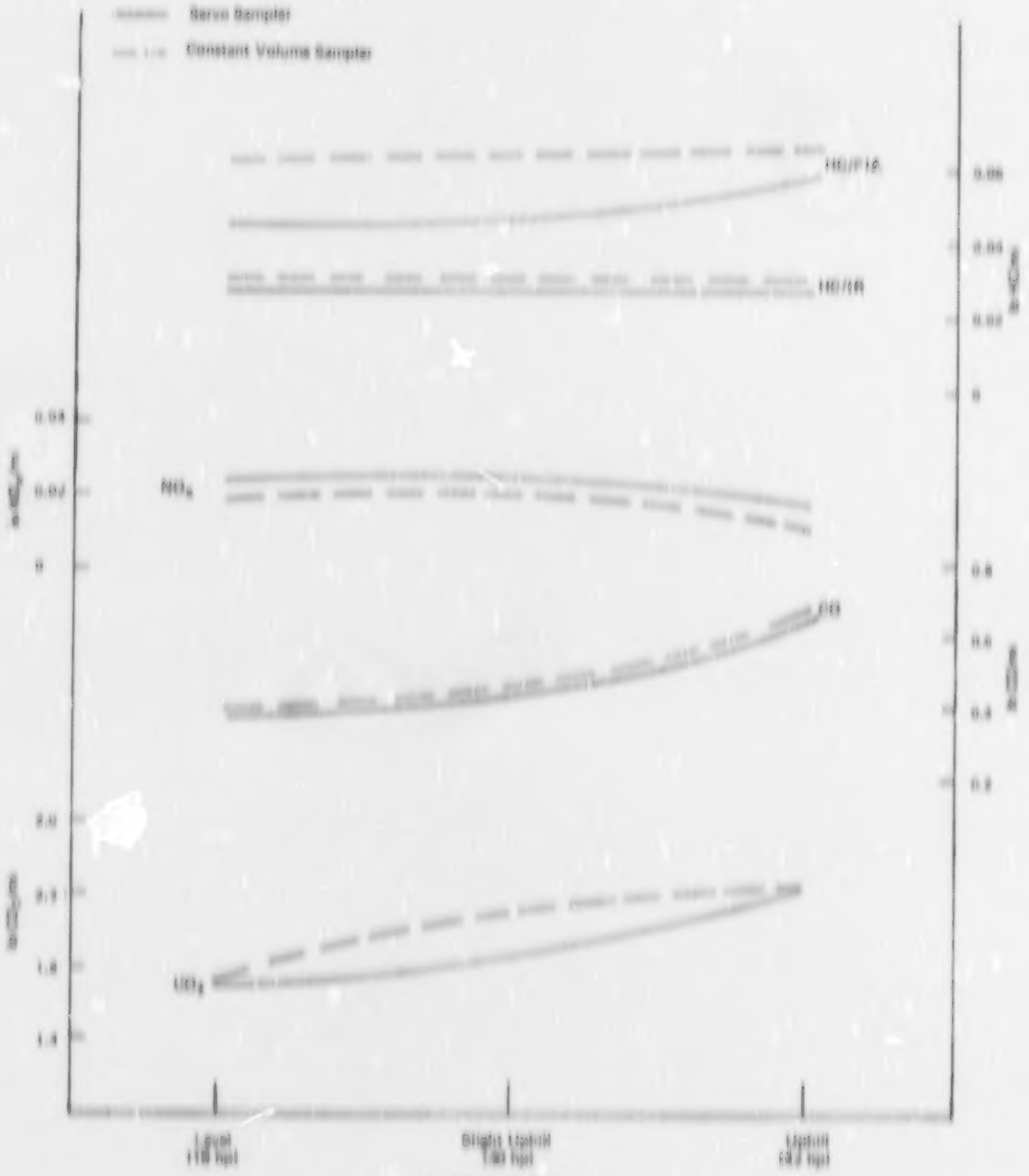

FIGURE 10. EFFECT OF ROAD LOAD ON CLASS III 1965 VAN TRUCK EMISSIONS—EXPERIMENTAL CYCLE

TABLE 11. CORRELATION OF EMISSIONS BY SERVO AND CONSTANT VOLUME METHODS, CLASS IV EXPERIMENTAL CYCLE*

Vehicle: 1966 Stake Truck, 24,000 lb GVW
Engine: 345 cu in., V-8

Fuel: Indolene
Cycle: See Table 3

Run Condition	Vehicle Power Obs. hp	Proportional Sampling Method		NDIR UBHC, lb/mi	FIA UBHC, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel Avg	Exhaust Flow, SCF/mi
Level Road Load	14	Servo	Max	0.0244	0.0498	0.0131	0.413	1.890	13.83	144.8
			Min	0.0229	0.0482	0.0125	0.416	1.812	13.75	140.5
			Avg	0.0236	0.0489	0.0127	0.421	1.844	13.79	142.7
		Constant Volume	Max	0.0252	0.0541	0.0701	0.456	2.095		
			Min	0.0245	0.0479	0.0161	0.406	1.890		
			Avg	0.0248	0.0517	0.0172	0.438	1.980		
		Comparison Ratio		1.05	1.06	1.35	1.04	1.07		
Uphill Road Load	19	Servo	Max	0.0250	0.0552	0.0216	0.418	2.570	13.17	189.0
			Min	0.0197	0.0434	0.0161	0.367	2.070	12.35	167.5
			Avg	0.0214	0.0478	0.0184	0.393	2.293	12.59	175.3
		Constant Volume	Max	0.0247	0.0542	0.0208	0.427	2.575		
			Min	0.0240	0.0520	0.0161	0.373	2.370		
			Avg	0.0243	0.0532	0.0188	0.397	2.490		
		Comparison Ratio		1.13	1.11	1.02	1.01	1.08		

*Supporting data shown on Tables 16 and 17 of Appendix C.

sampling techniques and both analysis methods were greater at the uphill than at the level road load condition. One exception was the FIA analysis of the constant volume sampler. NO_x and CO_2 likewise increased. CO, however, was less at the higher road load. The engine air/fuel ratio was slightly less at the higher load condition.

Shown in Table 12 are the results of a series of experiments with a 1967 Chevrolet stake body truck. These tests were conducted in the upper four speeds of the five-speed transmission (first gear was not used) with the rear axle ratio in "high speed" (low numerical ratio). The maximum, minimum, and average data in Table 12 are presented as in Table 10 for three load conditions. The comparison ratios indicate that the level of agreement between the constant volume and servoproportional sampling techniques was closer than that shown on Table 10 for the Class III van. Overall, hydrocarbons values were greater with the constant volume method than with the servoproportional method. The NO_x values were essentially the same by either sampling system with comparison ratios ranging from 0.93 to 0.98. Likewise, CO and CO_2 showed good agreement per ratios from 0.81 to 0.92 and 0.96 to 1.08, respectively. The overall comparison ratios, averaged by run condition, were 0.98 for level road load, 1.05 for slight uphill, and 0.99 for uphill road load. These average comparison ratios indicate an excellent correlation between the two sampling systems.

In Figure 11, the results listed in Table 12 are plotted by run condition. These plots show the level of agreement between the two sampling systems and the similar results obtained. As with the Class III truck, CO and CO_2 increased with dynamometer road load settings. Unlike the Class III vehicle, however, NO_x via proportional method increased as the load was increased. Hydrocarbon emissions measured by FIA decreased slightly with increasing load, while the NDIR hydrocarbons appeared to go through a peak at the midpower condition. It is interesting to analyze the emissions trends with the operating parameters of air/fuel ratio and engine exhaust flow rate in SCF/mi. As the road load was increased, the exhaust flow rate increased as expected. The air/fuel ratio, however, experienced a minimum of 13.13 at the slight uphill load; about 0.5 ratio less than at the level and uphill road load conditions. An apparent maximum hydrocarbon value, by NDIR, was recorded at the slight uphill load. The occurrence of maximum hydrocarbons during the richest overall mixture ratio of the three conditions may be easily explained. The CO_2 by the constant volume method also went through a slight minimum condition at the slight uphill condition which agreed with the higher hydrocarbon

TABLE 12. CORRELATION OF EMISSIONS BY SERVO AND CONSTANT VOLUME METHODS, CLASS IV EXPERIMENTAL CYCLE[a]

Vehicle: 1967 Stake Truck, 30,000 GVW
Engine: 366-cu in., V-8

Fuel: Indolene
Cycle: See Table 3

Run Condition	Vehicle Power Obs, hp	Proportional Sampling Method		NDIR UBHC, lb/mi	FIA UBHC, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel Avg	Exhaust Flow, SCF/mi
Level Road Load	12	Servo	Max	0.0193	0.0488	0.0260	0.161	2.14	13.7	150.0
			Min	0.0184	0.0464	0.0235	0.143	2.12	13.6	146.0
			Avg	0.0188	0.0478	0.0252	0.149	2.13	13.65	148.8
		Constant Volume	Max	0.0219	0.0515	0.0249	0.130	2.05		
			Min	0.0193	0.0460	0.0206	0.122	2.04		
			Avg	0.0205	0.0496	0.0238	0.128	2.048		
		Comparison Ratio		1.09	1.05	0.95	0.86	0.96		
Slight Uphill Road Load	23	Servo	Max	0.0259	0.0485	0.0286	0.1715	2.10	13.4	158.0
			Min	0.0208	0.0392	0.0268	0.1415	1.73	12.95	155.0
			Avg	0.0235	0.0436	0.0277	0.1608	1.91	13.13	156.4
		Constant Volume	Max	0.0283	0.0513	0.0300	0.175	2.10		
			Min	0.0252	0.0453	0.0246	0.131	2.05		
			Avg	0.0270	0.0488	0.0272	0.148	2.07		
		Comparison Ratio		1.15	1.11	0.98	0.92	1.08		
Uphill Road Load	34	Servo	Max	0.0224	0.0436	0.0449	0.224	2.90	13.70	204.0
			Min	0.0203	0.0401	0.0398	0.206	2.68	13.30	197.0
			Avg	0.0215	0.0419	0.0422	0.215	2.82	13.55	201.0
		Constant Volume	Max	0.0266	0.0492	0.0411	0.175	2.74		
			Min	0.0243	0.0410	0.0372	0.173	2.71		
			Avg	0.0252	0.0449	0.0391	0.174	2.73		
		Comparison Ratio		1.17	1.07	0.92	0.81	0.97		

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[a] Supporting data shown in Tables 22, 23, and 24 of Appendix C.

production at this point. The FIA hydrocarbon trend and the NO_x and CO emissions curves did not show this effect except for a slight maximum at the midload condition noted for the FIA hydrocarbons by the servoproportional sampling system.

In summary, the level of agreement between the constant volume and servocontrolled proportional sampling and analysis techniques was illustrated for a Class II vehicle operated on the twelve-mode experimental cycle, and for two Class IV vehicles operated on an experimental, twelve-mode cycle at several different road load dynamometer settings. The agreement between NDIR hydrocarbons, NO_x, and CO was satisfactory under all conditions investigated with the Class II 1968 stake truck and Class III 1965 van. Better agreement was obtained with the Class IV 1966 and 1967 stake trucks in all emission parameters measured. From this limited series of experiments, it appears that the constant volume system is capable of obtaining suitable dilute samples of engine exhaust for determination of mass emissions and that these results agree sufficiently well with the proportional system. The constant volume sampling system, like the proportional method, is sensitive to changes in vehicle operation.

C. Federal Heavy-Duty Gasoline Truck Cycle

The final series of experiments involving the correlation trucks was a series of tests using the Federal constant speed cycle. The dynamometer procedure, presented in Table 1, was originally proposed as a stationary or chassis dynamometer, nine-mode cyclic test. All SwRI data were taken simultaneously with a chassis dynamometer test using the continuous and constant volume samplers.

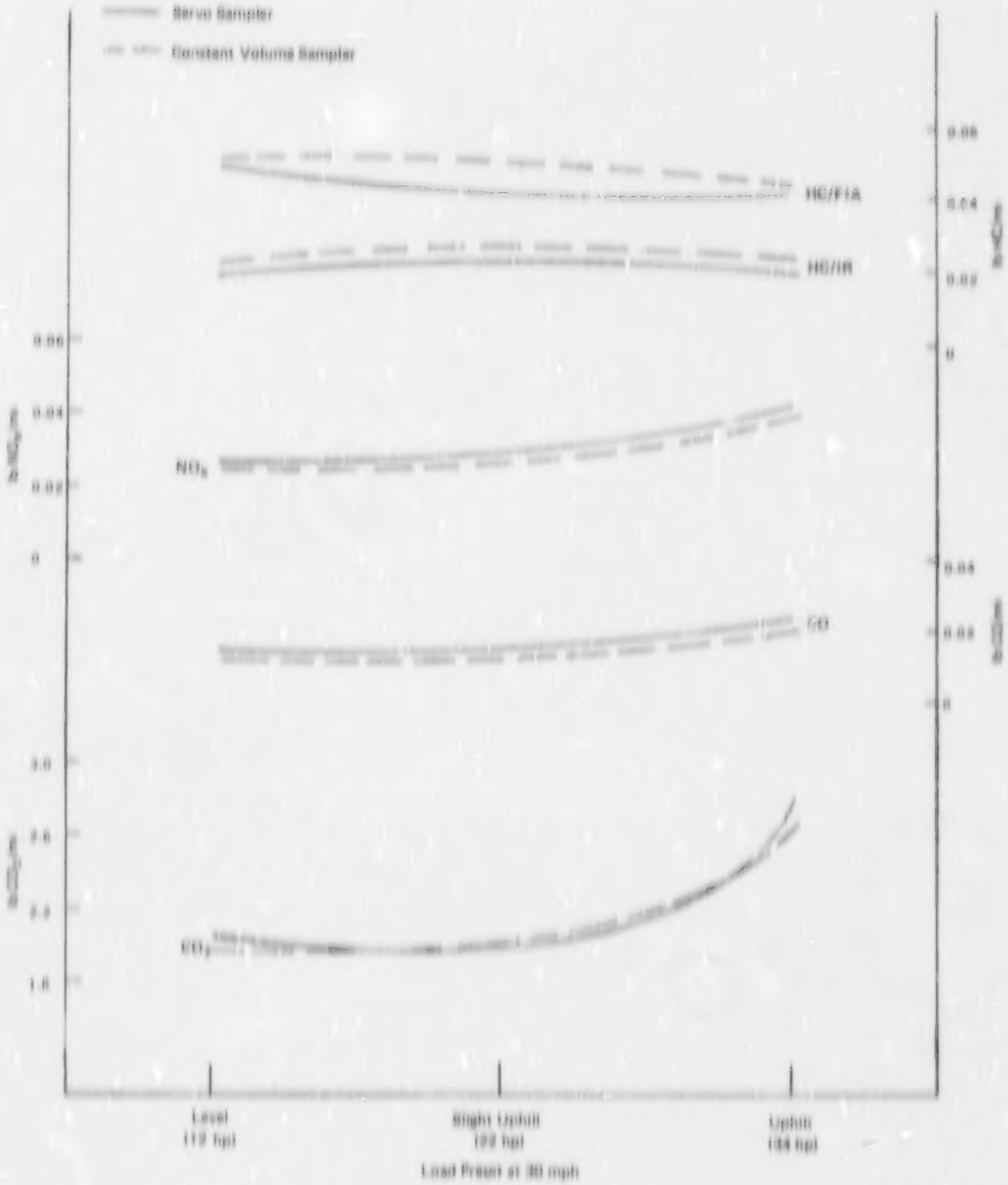

FIGURE 11. EFFECT OF ROAD LOAD ON CLASS IV 1967 STAKE TRUCK EMISSIONS: EXPERIMENTAL CYCLE

Table 13 is a tabulation of the emission results for the Federal cycle using both sampling systems. The top half of the table is a tabulation of the average weighted HC and CO data taken with the continuous sampler. The current Federal limits per Reference 7 are 275 ppm HC as n-hexane and 1.50 percent CO. Figure 12 is a bar graph of these results for all four vehicles under the Federal cycle. The bars of CO and HC emissions may be compared with the current Federal standards for an indication of each "uncontrolled" vehicle's emissions. Gross generalizations cannot and should not be made from this very limited sample.

TABLE 13. PROPOSED 1970 FEDERAL STANDARD HEAVY DUTY GASOLINE TRUCK CYCLE EMISSIONS

Cycle: Federal

Fuel: Indolene

		Continuous Sampling Analysis by NDIR		PHS Variable Dilution Sampling					
Weight Class	Vehicle Tested	HC/IR, ppm	CO, %	NDIR UHHC, lb/mi	FIA UHHC, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Exhaust Flow, SCF/mi
II*	1968 Stake 250 CID 6-cylinder	348.9	2.73	0.0664	0.0124	0.0207	0.134	1.072	77.6
III†	1965 Van 292 CID 6-cylinder	270	3.30	0.0137	0.0221	0.0267	0.249	2.08	1134
IV‡	1966 Stake 345 CID V-8	404	3.10	0.0148	0.0328	0.0179	0.233	1.78	1194
IV**	1967 Stake 366 CID V-8	238.5	1.52	0.01042	0.0221	0.0278	0.144	2.201	184

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*1968 stake supporting data in Tables 6 and 7, Appendix C.
†1965 van supporting data in Tables 13 and 14, Appendix C.
‡1966 stake supporting data in Tables 18 and 20, Appendix C.
**1967 stake supporting data in Tables 25 and 27, Appendix C.

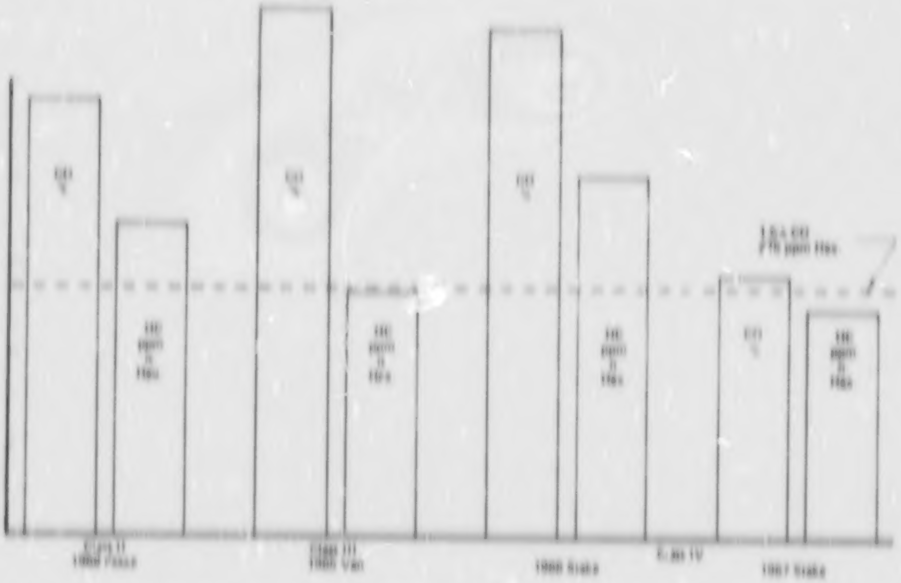

FIGURE 12. FEDERAL GASOLINE TRUCK CYCLE RESULTS

The mass emission data with the Federal cycle using the constant volume sampling technique are listed on the lower part of Table 13. For heavy trucks, there is no currently recognized method for correlating mass emissions of the constant volume sampling system to the concentration results using the continuous sampling technique.

A comparison of the emission results using the Federal and experimental cycles is shown in Table 14. The experimental cycle, representative of road emissions data, shows HC values via the constant volume sampling system to be much higher than the Federal cycle results. CO and CO_2 emission levels are also higher with the experimental cycle. Considering the effect of road load on the Class II truck results, NO_x emissions via the experimental cycle did not become greater than the Federal cycle until the "uphill" loading was applied. HC, CO, and CO_2, however, were greater than the Federal cycle regardless of load.

TABLE 14. COMPARISON OF CONSTANT VOLUME SAMPLING AND ANALYSIS RESULTS

Dynamometer Cycle	Run Condition	Power, Obs. hp	NDIR UBHC, lb/mi	FIA UBHC, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Exhaust Flow, SCF/mi
			Weight Class II – 1968 Stake, 230 cu in.					
Federal			0.00614	0.0124	0.0207	0.154	1.072	77.6
Experimental	Level		0.0202	0.0382	0.0192	0.2275	1.284	104.3
Experimental	Slight Uphill		0.0186	0.0384	0.0169	0.250	1.470	119.3
Experimental	Uphill		0.0190	0.0386	0.0245	0.304	1.683	139.2
			Weight Class III – 1965 Van, 292 cu in.					
Federal			0.0137	0.0221	0.0257	0.249	2.050	112.0
Experimental	Level Road	18	0.0259	0.0602	0.0180	0.383	1.794	135.8
Experimental	Slight Uphill	30	0.0288	0.0648	0.0205	0.466	2.121	148.5
Experimental	Uphill	43	0.0315	0.0674	0.0129	0.656	2.310	180.4
			Weight Class IV – 1966 Stake, 345 cu in.					
Federal			0.0143	0.0128	0.0150	0.233	1.73	119.0
Experimental	Level Road	14	0.0248	0.0517	0.0174	0.436	1.98	142.7
Experimental	Uphill	19	0.0242	0.0332	0.0188	0.397	2.49	175.3
			Weight Class IV – 1967 Stake, 366 cu in.					
Federal			0.01042	0.0221	0.0278	0.144	2.361	134
Experimental	Level Road		0.0205	0.0496	0.0238	0.128	2.048	149
Experimental	Slight Uphill		0.0270	0.0484	0.0272	0.148	2.070	156
Experimental	Uphill		0.0252	0.0440	0.0391	0.174	2.730	201

The Class III, 1965 van truck results indicate that hydrocarbons were less with the Federal cycle than those obtained by the experimental cycles with any of the three road load conditions. Oxides of nitrogen, however, were greater with the Federal cycle than any of the three load conditions investigated. CO and exhaust flow, like unburned hydrocarbons, were also lower when the vehicle was operated on the Federal cycle than when it was operated under the nonsteady-state procedure. CO_2 mass emission appeared to be about the same during the Federal cycle and the experimental cycle at the slight uphill load condition.

Comparing the Class IV 1966 IH stake truck Federal cycle and constant volume results, HC by NDIR and FIA, as well as CO, were noticeably lower than during the experimental Class IV cycle. Oxides of nitrogen were only slightly lower for the Federal test cycle than for the experimental cycle. As in the case of the Class III truck, exhaust flow was lower with the Federal test cycle. A comparison of the 1967 Chevrolet data tabulated on Table 14 shows the experimental cycle HC mass is considerably more than the HC values of the Federal cycle. The other emission measurements, CO, NO_x, and CO_2, showed an opposite trend in that the Federal emission results were greater.

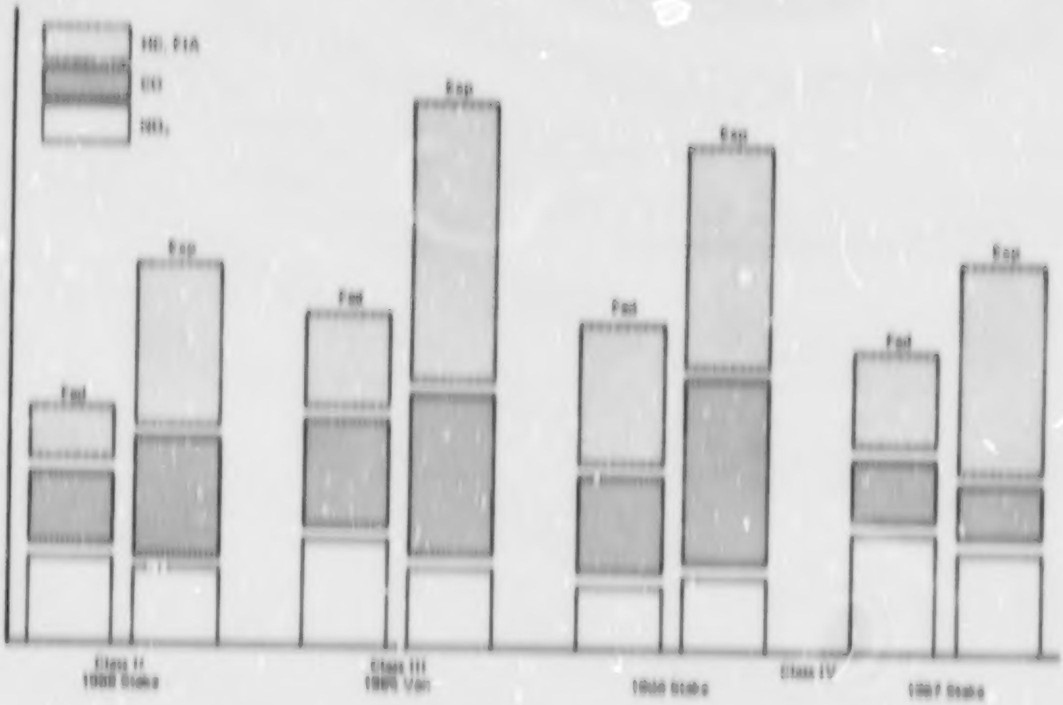

FIGURE 13. COMPARISON OF FEDERAL AND EXPERIMENTAL EMISSION RESULTS

Figure 13 compares the hydrocarbon, CO, and NO_x results of Table 14 for the four vehicles operated under the Federal cycle and the respective experimental cycle. Only the level road load experimental cycle data are plotted. Overall, both hydrocarbons and CO are less, sometimes substantially less, with the Federal cycle than with the exprimental cycle. On the other hand, NO_x is greater with the Federal than by the experimental except for the 1966 Class IV stake.

VII. BASELINE EMISSIONS TEST RESULTS

A total of 146 vehicles above 6,000 GVW, i.e., larger than a 1/2-ton pickup truck, powered by spark-ignition engines were surveyed to determine three things. First, their general operating characteristics and ability to perform on the respective experimental nonconstant speed cycle were determined. The second objective was to determine, using the experimental procedures, each vehicle's contribution to air pollution per mile driven on a mass basis. The third objective was to determine the applicability of the experimental cycles for routine use. A small group of Class IV liquid petroleum gas (LPG) fueled trucks and buses was also tested.

A. Baseline Truck Selection

Justification for the selection of the Class II, III, and IV baseline trucks was made with the aid of the statistical issue of "Automotive Industries," dated March 15, 1968[8]. The table entitled "New Truck Registrations by Makes and GVW, 1966-1967" was judged to be a representative tabulation of the truck population. On the basis that fifty trucks of each weight group would be tested, a breakdown by vehicle make and GVW was obtained.

According to the aforementioned statistical table, Chevrolet and Ford trucks comprise 75 percent of the Class II vehicles. On the basis of investigating 50 vehicles, 19 Chevrolet trucks and 18 Ford trucks were tentatively scheduled (see Table 15). The remaining 25 percent of the Class II was made up of six Dodge, four GMC, and three IH trucks.

For vehicles between 10,001 and 19,500-lb GVW, Class III, Chevrolet, Dodge, Ford, GMC, and International Harvester are the principal makes. As shown in Table 16, the number of trucks manufactured in the 10,001 to 14,000-lb GVW range was minor, justifying only two vehicles. In the 14,001 to 16,000-lb GVW category, this analysis indicates that three Chevrolets, one Dodge, three Fords, and one GMC should be considered. In the 16,001 to 19,500-lb GVW category, 18 Chevrolets, 2 Dodges, 13 Fords, 5 GMC's, and 1 IH would be needed.

TABLE 15. ANALYSIS OF 1966-1967 NEW TRUCK REGISTRATION FOR SELECTION OF CLASS II BASELINE DATA VEHICLES, 6,001 to 10,000 lb GVW

Vehicle Manufacturer	Total Trucks	Percent of Gross	Trucks Per 50
Chevrolet	211,981	38.00	19
Divco	1,054	0.19	
Dodge	61,852	11.10	6
Ford	201,024	36.20	18
GMC	47,543	8.57	4
IHC	28,581	5.15	3
Jeep-Truck	2,935	0.53	-
Total	554,973	100.14	50

TABLE 16. ANALYSIS OF 1966-1967 NEW TRUCK REGISTRATION FOR SELECTION OF CLASS III BASELINE DATA VEHICLES, 10,001 to 19,500 lb GVW

Vehicle Mfg	10,001 - 14,000 GVW Total Trucks*	10,001 - 14,000 GVW Percent of Gross	10,001 - 14,000 GVW Trucks Per 50†	14,001 - 16,000 GVW Total Trucks	14,001 - 16,000 GVW Percent of Gross	14,001 - 16,000 GVW Trucks Per 50	16,001 - 19,500 GVW Total Trucks	16,001 - 19,500 GVW Percent of Gross	16,001 - 19,500 GVW Trucks Per 50
Chevrolet				15,898	6.35	3	93,828	36.7	18
Divco	1,568	0.61	-				434	0.148	-
Dodge				4,729	1.85	1	15,448	6.06	2
Ford				12,882	5.05	3	66,883	26.2	13
GMC				4,865	1.91	1	25,697	10.1	5
IHC	8,193	3.21	2	1,076	0.421		3,317	1.36	1

*1966 and 1967 new truck registrations from "Automotive Industries," March 15, 1968, p 99.
†Above vehicle selection based on a total of 50 Class III trucks for baseline data acquisition.

A similar analysis is shown in Table 17 for Class IV, vehicles above 19,500 lb GVW. Since the new truck registrations apparently include both gasoline and diesel powered vehicles, the analysis made of Class IV statistics was not as straightforward as that for the Class III units. Even after deleting manufacturers who make mostly diesel and a few gasoline powered units, IH, GMC, and Ford contain an unknown number of units that are diesel powered. With this qualifying remark, some idea can be made of the distribution of vehicles by GVW and manufacturer. Most of the vehicles manufactured above 19,500 lb GVW are in the 19,500 to 26,000-lb range. Four Chevrolets, 2 Dodges, 10 Fords, 4 GMC's and 12 IH units were considered on the basis of registration statistics. In the 26,000 to 33,000-lb GVW range, only one Chevrolet, one Ford, two GMC's and three IH's were needed. Above 33,000 lb GVW, three Fords, two GMC's, and six IH's were desired.

TABLE 17. ANALYSIS OF 1966-1967 NEW TRUCK REGISTRATION FOR SELECTION OF CLASS IV BASELINE DATA VEHICLES

Vehicle Mfg	19,501-26,000 GVW			26,001-33,000 GVW			33,001 GVW and Over		
	Total Trucks*	Percent of Gross†	Trucks Per 50‡	Total Trucks	Percent of Gross	Trucks Per 50	Total Trucks	Percent of Gross	Trucks Per 50
Chevrolet	30,061	8.90	4	6,215	1.84	1	3,002	0.89	
Dodge	10,734	3.19	2	2,055	0.608		2,564	0.760	
Ford	68,445	20.2	10	9,073	2.68	1	18,297	5.41	3
GMC	26,348	7.8	4	9,863	2.92	2	9,957	2.96	2
IHC	80,640	23.8	12	21,598	6.40	3	38,625	11.40	6

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*1966 and 1967 new truck registrations from "Automotive Industries," p 99, March 15, 1968.
†Known makers of largely all diesel trucks such as Mack, FWD, White, etc., were left out of gross considerations. Diesel trucks in the above listings could not be backed out.
‡Above vehicle selection based on a total of 50 Class IV trucks for baseline data acquisition.

Of the number of trucks over 6,000 lb GVW, Class II trucks include 45 percent of all trucks registered in 1966 and 1967. Only 20 percent were Class III trucks and 35 percent were Class IV trucks. Also worthy of note was the fact that the 19,500-lb boundary between the Class III and IV vehicles appears in the center of the maximum registrations of heavy trucks.

In addition to a variety of makes and models, a variety of usage and maintenance practices was believed important. To obtain these baseline vehicles, it was necessary to involve several commercial operators of fleets as well as rental agencies. Rental agencies typically operate a number of vehicles of the same configuration, year, make, model, GVW, and tire size. To obtain the type of vehicles intended, it was necessary to gain access to large multipurpose fleets operated by the City of San Antonio, the City Public Service Board and, to a lesser extent, vehicles used by the San Antonio Transit System for maintenance and school buses operated by the Northside Independent School District.

Sanitation trucks for garbage pickup of all sizes and shapes were involved using both automatic and manual transmissions. Dump trucks, water trucks, stake body trucks, and van trucks were also obtained from the city fleet. These vehicles are routinely used for street and city work, in addition to the sanitation department. A wide variety of vehicles is used by the City Public Service Board which distributes gas and electrical power to the San Antonio area. These vehicles included "cherry-picker" type lineman service trucks, pole truck-tractors, lineman trucks, gas department meter servicing and pipeline installation trucks, as well as the usual stake body and van units involved in a typical operation of this sort.

A limited group of gasoline powered school buses was obtained from the Northside Independent School District to further represent the type of vehicles one might find in normal, everyday operation in a typical urban-suburban area. In addition to the three large fleets which were sampled, vehicles were obtained from other operations such as Howell Refining Company and Worcester Construction Company. In the case of the San Antonio Transit System, both Class II gasoline powered trucks as well as Class IV LPG powered city buses were obtained. The vehicles obtained from the Howell Refining Company were Class IV LPG powered single-axle tractors which are normally involved in intracity delivery of gasoline and fuel-oil products.

Shown in Figures 14 through 17 are polaroid snapshots of some of the vehicles involved in the baseline data phase of this program. Figure 14 shows some of the Class II vehicles and Figures 15 and 16 show some of the Class III and IV gasoline powered trucks. Figure 17 shows several views of the type and size LP gas powered tractor and city bus studied.

FIGURE 14. TYPICAL CLASS II BASELINE VEHICLES

FIGURE 15. TYPICAL CLASS III BASELINE VEHICLES

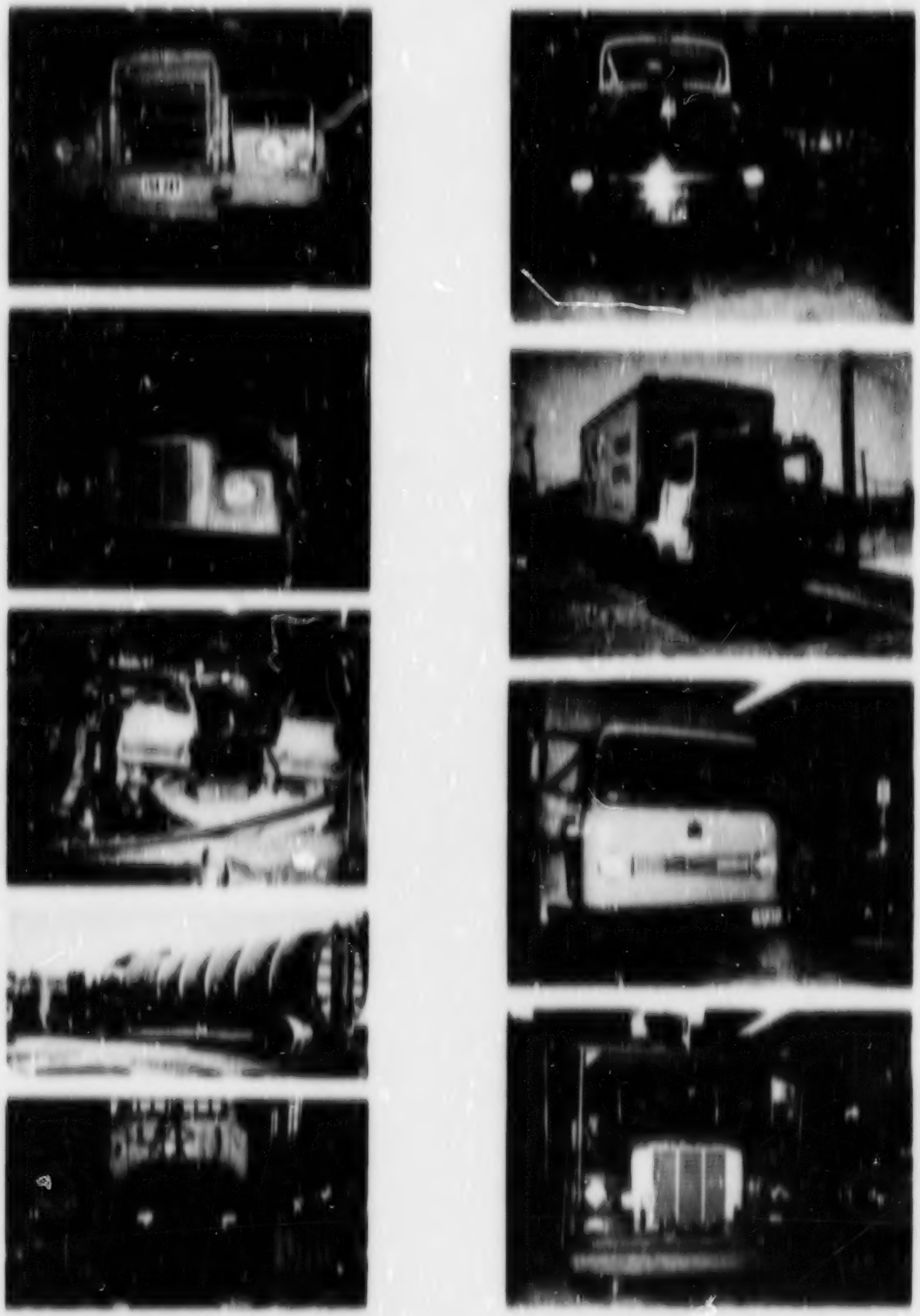

FIGURE 16. TYPICAL CLASS IV BASELINE VEHICLES

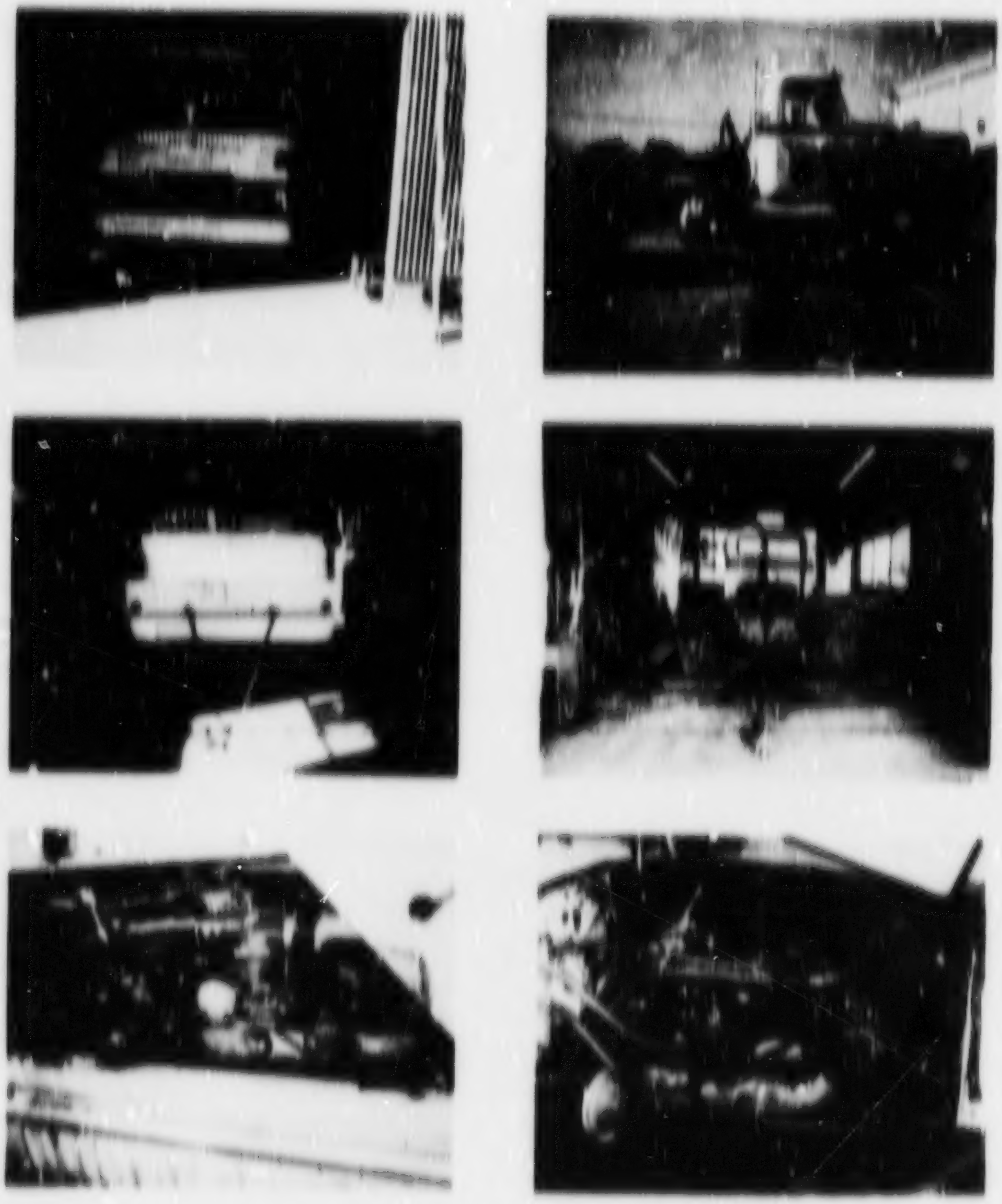

FIGURE 17. TYPICAL LPG FUELED BASELINE VEHICLES (CLASS IV)

The weight classification set forth in Reference 1 permits a number of heavy trucks to be classed in either of two weight groups. This is confusing, particularly when the same driveline and engine are used with only a change in licensing. To investigate possible difficulties, several 10,000-lb GVW trucks were run with the Class II and Class III cycle and several 19,500-lb GVW trucks were run with the Class III and Class IV experimental cycles. The results of these tests will be discussed in a later section of this report.

E. Baseline Emissions Test Preparation Procedures

Each vehicle was subjected to a limited inspection when received. An attempt was made to judge the running condition as poor, fair, or good and an assessment of the vehicle's ability to operate on the experimental cycle was obtained. An extensive two-page worksheet was prepared including polaroid snapshots of each vehicle. The worksheets were reduced to a single page listing pertinent descriptive performance and emissions data. This summary form, shown as Table 18, was prepared for each vehicle.

TABLE 18. CLASS ___ VEHICLE INSPECTION SUMMARY AND EXPERIMENTAL CYCLE DATA

Vehicle Number ________________ Date Inspected ________________

Vehicle Description
Make/year ______/______ Od.meter, miles ______
Source/service ______/______
GVW, lb ____________ Tire Size ________
Engine CID/cylinders ______/______
Transmission type/speeds ______/______
Axles, drive/dead ____/____ N/V ________

Preparation Data
At 30 mph level road, manifold vacuum was ______ in. Hg
resulting in _____ rear wheel power (rhp) at ______ rpm
engine speed. Timing was ____ °BTC at ______ rpm idle.
Observed engine condition ________________
Cycle adjustment ________________
____
____
Time to reach end of accel shifting mode: ________ sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C				
HC, FID, ppm C				
CO, NDIR, %				
CO_2, NDIR, %				
NO_x, Saltz, ppm NO_2				
NO, NDIR, ppm NO				

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile		
HC, FID, lb/mile		
CO, NDIR, lb/mile		
CO_2, NDIR, lb/mile		
NO_x, Saltz, lb/mile		
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile		

*Corrected for background.

The procedure followed was to first record descriptive data of the vehicle. The year and make of the truck, miles traveled prior to test, truck owner, type of service, GVW (or weight category), tire size, engine displacement and number of cylinders, transmission type and number of forward speeds, number of drive and dead axles, and the N/V ratio (defined as the engine rpm divided by the vehicle speed in high gear) were considered pertinent information.

Preparation data before the experimental cycle could be run included the establishment of a level road load power setting. This was accomplished by operating the various trucks on a level road at a constant 30 mph, monitored by a fifth wheel assembly. Recording and averaging the manifold vacuum over the to-and-from course gave a reference point such that the level road power absorbed at the wheels was set with the power absorbing unit of the chassis dynamometer. The power setting and engine speed at 30 mph were recorded. The engine timing was also measured to indicate possible deviation from the recommended setting. The engine idle speed was also recorded, but no adjustments to ignition or carburetion, timing, or idle speed were made. Since baseline tests were conducted on an "as is" basis, the observed engine condition was recorded. Ratings were given as good, fair, or poor.

Several cycles were run prior to the exhaust emission tests to determine if the operational characteristics of the truck could be fitted to the experimental cycle. If the experimental cycle had to be adjusted, a description of adjustments was included on the inspection summary. The adjustments for manual transmission trucks included changing the shifting points specified by the vehicle speed (mph) called out in the appropriate experimental cycle tabulation. Trucks equipped with automatic transmission always required cycle adjustments. Adjustments were made through the initial accel modes since, as a rule, WOT operation was not practical. The operator tried to duplicate a heavy throttle accel such that the automatic transmission progressed through a realistic shifting process. This operational procedure was recorded.

A soak time of 1 hr was held after preliminary cycle familiarization and between emission tests. The test bay area was kept between 68° and 86°F during the soak period and exhaust emission tests. A minimum of two tests was conducted per baseline vehicle.

The chassis dynamometers and their corresponding inertia systems used in the baseline study were described previously in Section IV of this report. At the start of the preparation section of this study, it was decided for simplicity that a set inertia would be used for each weight class. The tandem axle chassis dynamometer with 15,000-lb simulated vehicle weight was used for both the Class III and IV trucks. The installation of the single-axle dynamometer with multiple inertia capability permitted the use of 8,000-lb vehicle weight inertia simulation for the Class II vehicles.

The truck version of the PHS constant volume sampling system was used exclusively for acquiring baseline exhaust emissions. Bag samples were analyzed by the array of NDIR instruments described in Section III of this report. However, a NDIR instrument that indicates the concentration of nitric oxide (NO) in auto exhaust was obtained during the latter phase of the baseline emissions phase of the program. These NO data are presented for some of the baseline trucks.

G. Computation of Exhaust Emissions Results

The computation of mass emission results with the variable dilution sampler was described fully in the SwRI special report, Appendix A. This format was the same as used for the automotive version of the sampling system; however, there was no allowance for contaminants in the diluent on the mass emission, briefly explained in Section III. The following is a step-by-step calculation procedure that was used at SwRI to account for this unwanted "background." This particular procedure was reported in a letter report dated May 9, 1968, and was considered adequate at that time by the Project Officer. As explained in this letter, the procedure was established after phone and letter contacts with Mr. Bill Werner, then of the PHS Cincinnati Laboratories. Table 19 is the calculation format used and corresponds to the procedure description which follows:

PROCEDURE FOR COMPUTATION OF MASS EMISSIONS
USING THE VARIABLE DILUTION SAMPLER

The following data will be recorded directly after the run: blower speed, number of cycles operated, total revolutions of dynamometer rolls, total sampling time, number of cycles sampled, bag number of background bag, and sample transfer bag.

Meter readings of HC/IR, HC/FIA, CO, CO_2, and O_2 are recorded next for the sample transfer bag (t) and the background bag (b). Modified Saltzman method NO_x samples are taken at this point; however, since a time requirement to produce color is required, syringe numbers are recorded to identify the particular samples.

Beginning the calculation procedure, the trace of the inlet temperature to the sample pump is time averaged for an average sample temperature. This temperature is used to find the total SCFM of flow from the applicable calibration curve: total standard cubic feet flow per minute, variable dilution sampler at the given blower speed. The SCFM is recorded as the total volume (V_t).

Next, the miles traveled per cycle (D) is calculated by multiplying the total dynamometer revolutions by the conversion factor of 4.15×10^{-4} to obtain miles. This value is divided by the cycles operated.

It is now necessary to integrate the continuous raw exhaust CO_2 concentration trace. This is done by taking a time average of the total trace. The integrated value of raw CO_2 is used in computing the dilution ratio. The dilution ratio, ratio of diluent air to exhaust, is computed by dividing the raw CO_2 results by the CO_2 concentration of the sample transfer bag (CO_{2d}).

Proceeding to the next step on the data sheet, it is desirable to change the V_t into units of SCF/mi. This is accomplished by multiplying the SCFM value by the total sampling time (T) and dividing this product by the product of the number of cycles sampled (A) and the distance (D) in miles/cycle.

With the known total volume (V_t) of diluent air and exhaust flow of the sampler, the value of raw exhaust can be calculated by dividing (T_t) by the dilution ratio. This value of raw exhaust volume (V_e) is then subtracted from the total volume of sampler intake to obtain the volume of background gas (diluent air) taken through the sampler.

With values of (V_t) and (V_b), it is in order to follow a lateral left to right step-by-step procedure in calculating the mass emission as lb of emissions per mi traveled. Inserting values of (V_t) and (V_b) with their corresponding emissions in the third column, the fourth column can be calculated by multiplying the concentration (C) by the given volume (V_t) and (V_b). In order to extract the weighted background emission, the value of $V_tC_t - V_bC_b$ is recorded in Column 5. The background free emissions are then put in the identical units of %/100 (Column 6) and multiplied by the appropriate conversion factor to obtain mass emissions on a lb/mi basis.

TABLE 19. DATA SHEET FOR CONSTANT VOLUME SAMPLING SYSTEM

Truck No. ____________ Time ________ a.m. - p.m.
Run No. ____________
Date ____________ Vehicle Year/Make ____/____ Wet °F ________ Dry °F ________

Blower Speed ________ Number of Cycles Operated ______ Bar. Pressure, in. Hg ______ obs ______ corr
Total Rev of Dyno Rolls ________ rev Integrated Inlet to Sample Pump, T ________ °F
Integrated Raw CO_2 Concentration ________

T: Total Sampling Time ________ min
A: Number of Cycles Sampled ________
D: Mi/cycle: $\frac{\text{Total Dyno Rev} \times 4.15 \times 10^{-4}}{\text{Number of Cycles Operated}} = \frac{\_\_\_\_ \times 4.15 \times 10^{-4}}{\_\_\_\_} =$ ________ mi/cycle
DR: Dilution Ratio = CO_2 raw/CO_2 diluted ______/______ = ________
V_t: Total SCFM from Applicable Calib Curve: ________ SCFM × $\frac{\_\_\_\_ T}{\_\_\_\_ A \_\_\_\_ D}$ = ________ SCF/mi
V_e: Volume of Raw Exhaust: $\frac{V_t}{DR}$ ______/______ = ________ SCF/mi
V_b: Volume of Background Gas: $V_t - V_e$ = ________ - ________ = ________ SCF/mi

Meter Reading	Concentrations (C)		V_t or V_b	V_tC_t or V_bC_b	$V_tC_t - V_bC_b$	$V_tC_t - V_bC_b$ %/100	lb Mol Wt / 385.2	lb/mi
	HC/IR_t	ppm C					0.03597	
	HC/IR_b	ppm C						
	HC/FIA_t	ppm C					0.03597	
	HC/FIA_b	ppm C						
	CO_t	%					0.07269	
	CO_b	%						
	CO_{2t}	%					0.11422	
	CO_{2b}	%						
	NO_{xt}	ppm					0.11940	
	NO_{xb}							

(t) NO_x syringe No. ________ Bag No. ________ (b) NO_x syringe No. ________ Bag No. ________

O_{2t}: ____________ mm
O_{2b}: ____________ mm

Motor Vehicle Emission Lab
LIBRARY

D. Baseline Gasoline Emissions

One-hundred and thirty-five gasoline powered vehicles above 6,000 lb GVW were studied to determine the baseline emissions from heavy-duty vehicles. Contained in Appendix D are the results for each vehicle investigated, first for the Class II (Tables D-1 through D-31), then for Class III (Tables D-32 to D-88), and finally, Class IV (Tables D-89 to D-135). In an addition to a description of the vehicle and the preparation necessary for its operation, each summary sheet lists the constant volume sampling and analysis results on a mass, lb per mi, basis.

The three principal emissions of interest were CO, HC, and NO_x. HC data were obtained by both NDIR (ppm n-hexane) and by FIA as ppm carbon. In discussing the baseline data, the NDIR HC values were used because the current Federal standard for heavy-duty gasoline engines makes use of this instrument. Essentially the same trends, however, could have been shown on the basis of the FIA results. NO_x results were obtained by the modified Saltzman (all vehicles) and by NDIR, ppm NO, for a few vehicles during the latter part of the project. Since the modified Saltzman was employed throughout, the discussion will be in terms of NO_x by Saltzman. Most of the time, the NDIR NO data substantiates the Saltzman results, but there are cases in which this did not occur. These occasional discrepancies are being investigated.

Based on the gasoline emissions inspections contained in Appendix D, rank ordering of each weight class of vehicles for CO, HC, and NO_x was accomplished. The result of this analysis is contained in Appendix E. Table E-1 is a chronological summary of each of the Class II vehicles evaluated. Tables E-2 through E-4 list the Class II CO, HC, and NO_x data, respectively, starting from lowest to highest. Table E-5 is a chronological listing of each of the Class III vehicles evaluated. Tables E-6 through E-8, similar to the Class II tables, rank order from lowest to highest the CO, HC, and NO_x for the Class III trucks. In identical form, Tables E-9 and E-10 through E-12 summarize and rank order the Class IV vehicle baseline emissions.

In addition to each individual vehicle's contribution of CO, HC, and NO_x, it was also desirable to know what a particular vehicle's overall contribution might be where the three major contaminants are considered at once. Because of the obvious differences in concentration values of ppm versus percentages, it is not possible to numerically add the three contaminants to obtain a total score for each vehicle. An involved statistical method might be applied if one knows how much to weight the HC, CO, and NO_x values as they affect air pollution. This approach, however, requires careful assessment of weighting factors which, to our knowledge, are not as yet available for heavy-duty vehicles. In an attempt to combine these three emissions, it was arbitrarily decided that each should have equal weight. From this premise, each group of vehicles was split into thirds by its rank order of contribution, i.e., from lowest to highest contribution. Those trucks grouped in the top 1/3 were given a score of one, the middle 1/3 were given a score of two, and the highest 1/3 given a score of three. With three emissions involved and three groupings for each emission (CO, HC, and NO_x), it is possible for a vehicle to have a total score of somewhere between three and nine.

Once this ranking was accomplished, it was decided, again somewhat arbitrarily, that the vehicles should be grouped in three categories. The first category of vehicles, having total scores of three and four, were called "low." Those with overall scores of five, six, and seven were called "moderate," and those with total scores of eight and nine were called "high."

Using the rank order table summaries from Appendix E, an overall rating was given for each vehicle in each class by adding together the CO, HC, and NO_x individual ratings. The results for the Class II gasoline fueled survey are listed on Table 20 of the text. Those vehicles with a rating of three and four are listed first and an average obtained for this group's emissions. Those vehicles with overall rating of five, six, and seven are grouped next and account for the bulk of the vehicles evaluated. The "high" group is shown on the bottom of Table 20 and included vehicles that received ratings of eight and nine. In a similar fashion, the Class III and Class IV results are rank ordered and grouped on

TABLE 26. CLASS II BASELINE (GASOLINE FUELED) EMISSIONS RESULTS SUMMARY

Run No.	Year	Make	Vehicle Mileage	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	Engine Condition	HC/IR, lb/mi	HC/FIA, lb/mi	CO, lb/mi	CO$_2$, lb/mi	NO$_x$, lb/mi	NO, lb/mi	Exh Flow, SCFM	Rating
								"Low" Emissions Category								
II-17	1959	Chev	99,367	235	6	9,600	56.7	Fair	0.0227	0.0541	0.284	1.725	0.0106	0.0161	153	3
II-2	1965	Chev	45,752	230	6	10,040	55.0	Fair	0.0203	0.0271	0.282	1.135	0.0108	—	109	4
II-21	1965	Chev	1,394	250	6	10,000	51.7	Good	0.0191	0.0359	0.263	1.470	0.0106	0.0104	173	4
Avg			48,831				54.5		0.0204	0.0377	0.276	1.443	0.0107	0.0132	145	
								"Moderate" Emissions Category								
II-5	1968	IHC	601	304	8	10,000	53.3	Good	0.0276	0.0552	0.261	1.895	0.0255	0.0106	194	5
II-20	1968	Chev	239	250	6	7,500	46.7	Good	0.0189	0.0309	0.421	1.640	0.0079	0.0079	134	5
II-12	1968	Dodge	185	318	8	10,000	53.3	Good	0.0180	0.0359	0.495	2.145	0.0106	0.0135	176	5
II-24	1967	Ford	26,785	240	6	6,000	43.3	Fair	0.0327	0.0596	0.201	1.527	0.0055	0.0047	143	5
II-25	1967	Ford	32,945	240	6	6,000	47.5	Fair	0.0304	0.0575	0.359	1.297	0.0056	0.0040	145	5
II-27	1966	Ford	29,606	240	6	7,500	43.3	Fair	0.0171	0.0356	0.396	1.280	0.0110	0.0077	125	5
II-26	1960	Ford	48,949	223	6	7,400	55.0	Good	0.0240	0.0465	0.239	7.360	0.0154	0.0064	229	5
II-29	1966	Ford	17,305	240	6	10,000	51.7	Fair	0.0173	0.0373	0.430	3.610	0.0100	0.0077	324	5
II-30	1960	Ford	57,989	223	6	7,400	56.3	Fair	0.0207	0.0426	0.301	1.610	0.0112	0.0065	149	5
II-31	1968	Chev	6,050	250	6	10,000	53.4	Good	0.0189	0.0375	0.250	1.385	0.0104	—	111	5
II-3	1968	IHC	51	304	8	10,000	51.7	Good	0.0304	0.0652	0.311	1.600	0.0154	0.0107	147	6
II-6	1962	Dodge	4,951	225	6	10,000	53.3	Fair	0.0254	0.0454	0.307	1.542	0.0055	0.0128	129	6
II-7	1967	IHC	1,226	304	8	8,000	53.3	Good	0.0333	0.0629	0.242	1.545	0.0156	0.0155	135	6
II-8	1966	Ford	29,105	240	6	10,000	53.3	Fair	0.0279	0.0554	0.260	1.885	0.0207	0.0206	152	6
II-15	1966	Ford	27,895	240	6	10,000	50.0	Good	0.0168	0.0360	0.319	2.385	0.0092	0.0091	205	6
II-16	1961	Ford	94,223	223	6	10,000	50.0	Fair	0.0508	0.0985	0.336	1.692	0.0106	0.0025	156	6
II-19	1959	Chev	7,704	235	6	9,600	56.7	Fair	0.0335	0.747	0.216	1.915	0.0134	0.0016	178	6
II-4	1963	Ford	93,196	223	6	9,000	66.7	Fair	0.0327	0.0614	0.175	1.677	0.0285	0.0201	154	7
II-13	1964	Ford		223	6	10,000	56.7	Good	0.0509	0.0921	0.594	1.385	0.0099	0.0083	143	7
II-22	1966	Ford	25,627	240	6	10,200	51.7	Fair	0.0330	0.0594	0.277	1.965	0.0100	0.0070	179	7
II-9	1966	Ford	24,785	240	6	10,000	56.7	Fair	0.0234	0.0462	0.401	1.960	0.0130	0.0055	159	7
Avg			25,430				53.0		0.0280	0.0540	0.326	1.800	0.0137	0.0095	165	
								"High" Emissions Category								
II-1	1963	Ford	89,897	223	6	9,000	60.0	Fair	0.0240	0.0882	0.399	1.560	0.0162	—	136	8
II-10	1968	Dodge	552	318	8	10,000	53.3	Good	0.0237	0.0466	0.399	1.811	0.0106	0.0100	152	8
II-14	1966	Ford	27,770	240	6	10,000	50.0	Good	0.0236	0.0470	0.441	2.130	0.0160	0.0075	201	8
II-18	1964	Ford	77,555	223	6	10,000	65.0	Poor	0.0496	0.0882	0.390	1.775	0.0156	0.0122	180	8
II-23	1968	Chev	4,864	250	6	7,500	50.0	Fair	0.0363	0.0664	0.409	1.850	0.0119	0.0034	180	9
II-11	1965	Ford	44,291	240	6	10,000	56.7	Fair	0.0384	0.0774	0.455	1.485	0.0162	0.0055	151	9
Avg			40,506				55.8		0.0326	0.0623	0.416	1.769	0.0157	0.0049	166	

Tables 21 and 22, respectively. These tables not only list the emissions but give sufficient descriptive data as to the vehicle's age, make, mileage, displacement, cylinder arrangement, GVW-N/V ratio, and engine condition to relate the emission individually or cumulatively by category.

To gain additional information about a particular vehicle as to how well its CO, HC, or NO_x results rank ordered with other vehicles in its class, the respective table in Appendix E may be referred to. For information on how a particular vehicle operated on the cycle, whether or not adjustments were necessary to its operation, the type of service such as routine delivery, stake, van, tire size, etc., or number of forward gears in the transmission, please refer to the respective run number summary sheet in Appendix D.

Using the averages for each category of "low," "moderate," and "high," bar graphs were prepared which illustrate the variation between each weight class. Figures 18, 19, and 20 illustrate the variability for all three classes of these averages made on the basis of the relative rankings for CO, HC, and NO_x, respectively. From the CO and HC bar graphs, Figures 18 and 19, it is difficult to observe a consistent trend of one class relative to the other two classes. In the case of NO_x, however, it appears that the Class II vehicles, as a class, produced less NO_x than the Class III and the Class III vehicles slightly less than the Class IV. This was found to be consistent throughout the "low," "moderate," and "high" categories.

It should be mentioned that when this program began it was desired to express emissions on the basis of pounds mass per mile driven as this was the practice used in Reference 1. During the course of this program, however, terminology changed to grams per mile; that used in the Federal standards.

For convenience to the reader, a separate scale is shown in which the pounds per mile values have been converted to the equivalent grams per mile.

A more elementary way of analyzing the baseline data is to consider the max, min, and average for each weight category. The results of this type analysis are shown in Figures 21 through 23 for CO, HC, and NO_x. Each bar graph compares the max, min, and overall arithmetic average emissions for each weight class in both pounds and grams per mile. It is not possible to directly compare these bar graphs with those shown in Figures 18 through 20 because of the relative ranking method employed to determine the "high," "moderate," and "low" categories. Trendwise, in a majority of instances, the bar graphs appear to agree, however.

Another analysis that was made involved consideration of the effect of year, make, vehicle mileage, engine displacement, number of cylinders or cylinder arrangement, GVW, and engine condition on emissions. Considering the data grouped by overall relative ranking on Tables 21 through 23, it is difficult to make a substantial correlation between any of these factors with total emissions behavior. Of all the factors, engine condition, which was judged by a trained technician to be either good, fair, or poor, seemed to be more indicative than the other factors, although a strict correlation cannot be claimed. In the case of the Class III vehicles, Table 21, a number of trucks in the "low" category were judged to be in good condition whereas those in the "high" category were judged to be in fair condition. This relationship, however, did not appear quite as strong for the Class II or Class IV vehicles.

In essence, it didn't seem to make much difference whether the engine was a six or an eight cylinder, whether it was a particular make or model, or had more or less miles. As may be seen, the "low" category for all classes included vehicles with varying mileage, as was the case for vehicles classified in the "high" group. The only notable exception to this was for the Class IV "low" category which, with the exception of one vehicle, all had less than 5,000 miles. Possibly a more detailed analysis of mileage and type of service would reveal a correlation with emission level. This analysis would require a formulation involving year, make, and type of service along with the accumulated mileage. In addition, the gross ratings given to apparent engine condition, i.e., good, fair, or poor, were basically made from an overall judgment. Time did not permit extensive evaluation or investigation of spark plug condition, compression pressures, and ignition dwell, for example. These types of correlations were considered beyond the intended scope of this program.

TABLE 2[illegible] CLASS III BASELINE (GASOLINE FUELED) EMISSIONS RESULTS SUMMARY

[illegible]

TABLE 77 CLASS IV BASELINE (GASOLINE FUELED) EMISSIONS RESULTS SUMMARY

Run No.	Year	Make	Vehicle Mileage	Engine Displacement in³	No. of Cylinders	GVW lb	A/F Ratio	Engine Condition	[illegible]	[illegible]	CO g/mi	CO₂ g/mi	NOₓ g/mi	[illegible]	[illegible]	Rating
"Low" Emissions Category																
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Avg			7,138			23,573	58.9		0.0151	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	136	
"Moderate" Emissions Category																
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Avg			[illegible]			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
"High" Emissions Category																
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Avg			[illegible]			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

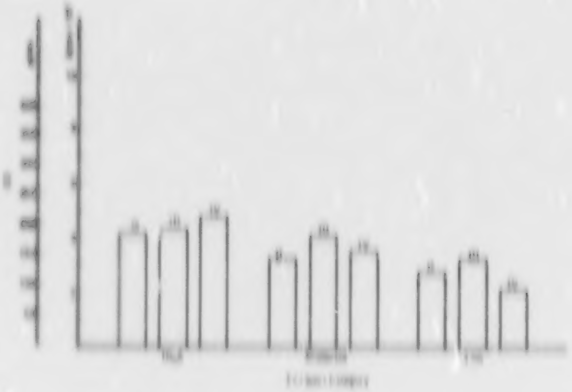

FIGURE 18. COMPARISON OF CO EMISSIONS ON BASIS OF EMISSION CATEGORY RANK ORDER

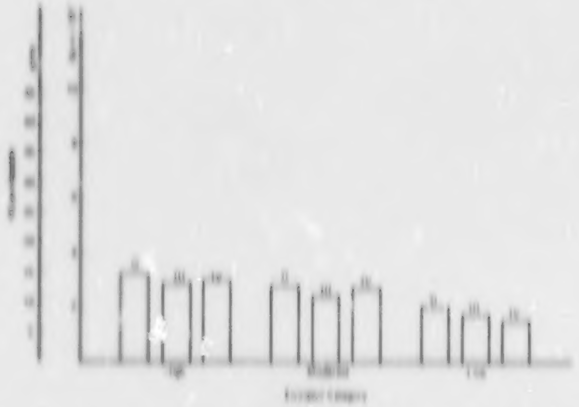

FIGURE 19. COMPARISON OF HC (NDIR) EMISSIONS ON BASIS OF EMISSION CATEGORY RANK ORDER

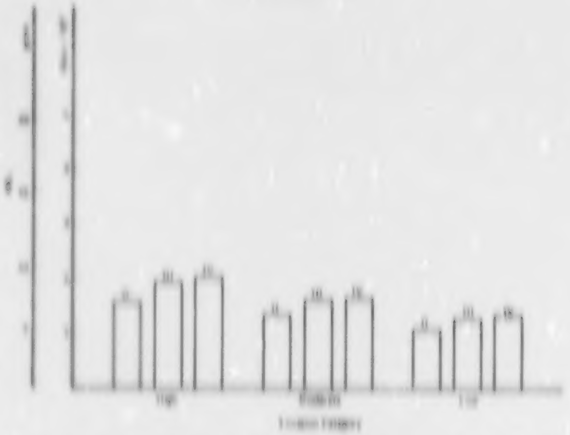

FIGURE 20. COMPARISON OF NO_x EMISSIONS ON BASIS OF EMISSION CATEGORY RANK ORDER

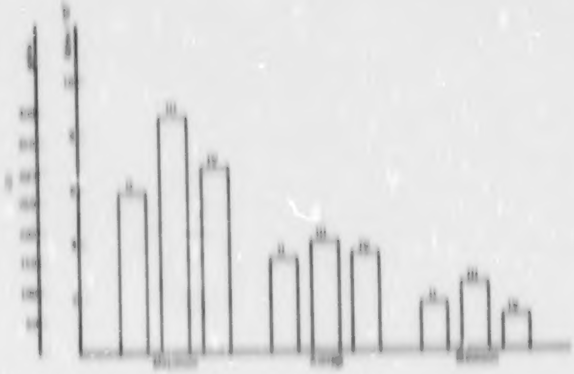

FIGURE 21. COMPARISON OF CO EMISSIONS ON BASIS OF INDIVIDUAL VEHICLES

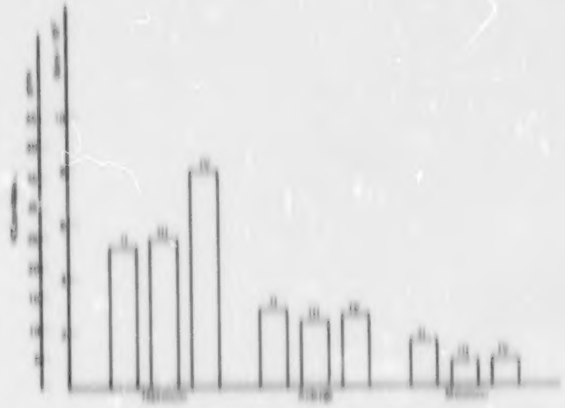

FIGURE 22. COMPARISON OF HC (NDIR) EMISSIONS ON BASIS OF INDIVIDUAL VEHICLES

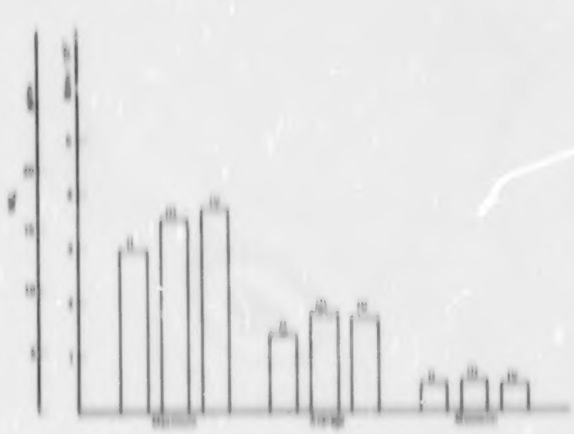

FIGURE 23. COMPARISON OF NO_x EMISSIONS ON BASIS OF INDIVIDUAL VEHICLES

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E. Baseline LPG Emissions

Eleven Class IV LPG (Liquid Petroleum Gas) powered vehicles were operated to obtain baseline emissions and gain additional insight to the applicability of the experimental cycle. Due to availability, this fleet of LPG vehicles consisted of only two types: six 27,000-lb GVW IH truck-tractors powered by IH inline, six-cylinder, 406-CID engines, and five 35,000-lb GVW Twin Coach buses powered by Fageol inline, six-cylinder, 404-CID engines.

The results from this group are summarized on Table 23, first for the six truck-tractors and then the five city buses. Emissions are averaged for the tractors and buses separately and an overall average for the 11 LPG vehicles is listed at the bottom of the table. (See also Appendix F.) To place the LPG data of Table 23 in perspective with other Class IV vehicles fueled with Indolene gasoline, the bar graph, Figure 24, may be helpful. Shown on this figure are the overall average HC by NDIR and FIA, CO, and NO_x emissions for both LPG and gasoline. This comparison indicates that the HC is lower with LPG by both methods of analysis, substantially less on a total or FIA basis.

HC values by NDIR were 0.0166 lb/mi (LPG) versus 0.0266 lb/mi (gasoline). The total HC reveals an even greater reduction for the LPG vehicles, that is, 0.0187 lb/mi (LPG) and 0.0480 lb/mi (gasoline). The NDIR (n-hexane) to total HC (FIA) ratio for the LPG vehicles was 1.125 overall as compared to 1.805 overall ratio for the gasoline fueled vehicles. The CO mass emissions were almost the same. Oxides of nitrogen measured by the modified Saltzman method and the NDIR NO measurement shown an approximate 35-percent decrease in these emissions with the LPG powered vehicles.

The analysis of these data are not intended to suggest that the LPG vehicles as a class necessarily have lower HC and NO_x emissions, because the group of LPG vehicles was small and limited to only two engines. The LPG powered vehicles performed well under the Class IV experimental cycle and cycle adjustments were not required. The LPG vehicles, though a small part of the baseline data, rounded out this survey and future studies of heavy-duty vehicles (SI) should include similar investigations. It would be interesting to obtain chromatographic analysis of hydrocarbon types in the exhaust to investigate the apparent lack of "heavy" or nonparaffinic HC in the exhaust as indicated by the FIA and NDIR results.

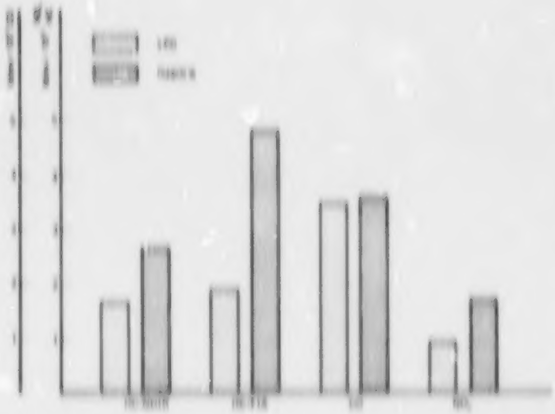

FIGURE 24. COMPARISON OF LPG TO CLASS IV GASOLINE EMISSIONS

(Arithmetic Average)

TABLE 21. LPG POWERED BASELINE EMISSIONS SUMMARY

(Class IV Vehicles)

Run No.	Year	Make	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	Vehicle Mileage	HC(IR), lb/mi	HC(FIA), lb/mi	CO, lb/mi	CO$_2$, lb/mi	NO$_x$, lb/mi	NO, lb/mi	Exh Flow, SCFM
							Truck-Tractors (Single Drive Axle)							
IV-1P	1963	IHC	406	6	27,000	53.0	291,226	0.0072	0.0087	0.182	2.029	0.0148	0.0139	184.5
IV-2P	1962	IHC	406	6	27,500	48.2	251,778	0.0360	0.0455	0.284	1.450	0.0054	0.0106	147.0
IV-3P	1962	IHC	406	6	27,400	48.3	334,034	0.0162	0.0230	0.649	1.425	0.0085	0.0109	197.0
IV-4P	1962	IHC	406	6	27,000	48.3	279,392	0.0179	0.0312	0.510	1.870	0.0085	0.0105	257.5
IV-5P	1953	IHC	406	6	27,000	48.3	416,656	0.0517	0.0428	0.597	1.685	0.0110	0.0101	177.0
IV-6P	1962	IHC	406	6	27,000	48.3	572,016	0.0102	0.0146	0.427	1.650	0.0034	0.0094	166.0
					Exh Emissions Avg -			0.0187	0.0244	0.442	1.666	0.0083	0.0111	184.8
							Municipal Buses							
IV-7P	1950	Twin Coach	406	6	25,000	58.3	304,294	0.0102	0.0118	0.226	1.735	0.0082	0.0148	125.0
IV-8P	1956	Twin Coach	406	6	25,000	57.6	595,290	0.0096	0.0096	0.280	1.345	0.0107	0.0134	125.0
IV-9P	1950	Twin Coach	406	6	25,000	58.2	577,617	0.0080	0.0095	0.146	1.695	0.0160	0.0157	124.5
IV-10P	1950	Twin Coach	406	6	25,095	58.2	576,482	0.0095	0.0089	2.182	1.590	0.0102	0.0129	149.0
IV-11P	1950	Twin Coach	406	6	25,000	57.8	555,746	0.0146	0.0109	0.235	1.492	0.0091	0.0127	134.0
					Exh Emissions Avg -			0.0091	0.0099	0.194	1.241	0.0079	0.0136	132.6
				Truck-Tractor + Municipal Buses Exh Emissions Avg -				0.0166	0.0197	0.347	1.507	0.0093	0.0124	155.1

VIII. APPLICABILITY OF EXPERIMENTAL CYCLES

One of the important objectives of this program was to determine the applicability of the experimental cycles by using them with as wide a variety of trucks as possible. To this end, trucks of all types with differing driveline arrangements were obtained to see if the respective cycle could accommodate the vehicle satisfactorily.

A. Cycle Adjustments

Sometimes the cycle had to be adjusted to enable a four-speed manual transmission or an automatic transmission to be used. Occasionally a vehicle would be termed "underpowered" as far as the cycle was concerned and adjustments required. In most instances, the major difficulties were with the accel from idle to cruise speed through the gears.

Table 24 is a tabulation of the manual transmission trucks that required various cycle adjustments. The Class II trucks are listed first and represent "underpowered" trucks as far as operation on the cycle was concerned. The first two trucks required higher intermediate shifting speeds such that the total specified accel time through the gears could be met. In effect, the shifts from second to third and third to fourth occurred 2 to 3 miles above that listed for the experimental Class II cycle. The third truck, Run No. II-26, would not meet the cycle time requirements. This 1966 vehicle was in very poor running condition. The remaining two trucks needed a heavier throttle setting for the PT accel, Mode 8, of the Class II experimental cycle. The average CO mass emission for the "underpowered" vehicles was higher than the overall average CO mass emission for Class II. HC and NO_x for the "underpowered" trucks, however, were slightly lower than the overall Class II baseline averages.

Fifteen of the 47 Class III trucks required some type of cycle modification and are listed next on Table 24. Each of these trucks was considered "underpowered" except trucks III-36 and III-40. These two trucks needed an extra accel shifting mode as they were equipped with a five- instead of a four-speed transmission. The remaining 13 trucks required intermediate shifting speed adjustments so that the required accel time could be met. These adjustments involved moving the shifting speed 2 to 3 miles higher. Otherwise, all trucks met the cycle and the observed exhaust emissions were not greatly affected. On an average, the CO and HC were slightly higher and the NO_x slightly lower than the overall Class III baseline truck averages.

The Class IV trucks requiring experimental cycle adjustment were those incorporating a four-speed instead of a five-speed transmission. None of the Class IV vehicles was termed "underpowered." The Class IV experimental cycle used at SwRI was for vehicles with five speed transmissions in which the initial accel is in second gear. By employing normal shifting, three accel modes could be substituted for the normal four accel modes without driving difficulty. The average exhaust HC and CO emissions for this group of four-speed transmission trucks were lower than the average Class IV HC and CO emissions. NO_x, however, was slightly higher.

Automatic transmissions involving three to six forward speeds are becoming more popular in certain types of delivery vehicles. They permit improved route speeds in stop and go operations like municipal buses, trash and garbage pickup, etc. Table 25 is a summary of the automatic transmission trucks investigated and their emissions. Most of these trucks were powered by relatively new V-8 engines with low mileage. All the trucks had more then adequate power response when operating on their respective experimental cycle. The garbage trucks had 0 to 30-mph performance that was superior to any other vehicle evaluated. The characteristics of the drive train precluded operation of the Class IV trucks at WOT during the initial accel as upshifting was delayed and operation was judged atypical. With the consent of the Technical Officer, all of the automatic transmission trucks were operated through the shifting accel modes at the minimum manifold vacuum setting such that normal automatic shifting occurred. The manifold vacuum was recorded along with the total time of idle plus the time required to reach accel through the

TABLE 26. MANUAL TRANSMISSION VEHICLES REQUIRING CYCLE ADJUSTMENTS

(All Classes)

Run No.	Year	Make	Engine Displacement in^3	No. of Cylinders	GVW, lb	N/V Ratio	Vehicle Mileage	HCDIR, lb/mi	HCFIA, lb/mi	CO, lb/mi	CO$_2$, lb/mi	NO$_x$, lb/mi	NO, lb/mi	Exh Flow, SCF/mi
II-4	1966	Ford	240	6	10,500	53.3	29,105	0.0234	0.0462	0.480	1.966	0.010	0.0125	159
II-18	1964	Ford	223	6	10,000	65.0	77,555	0.0496	0.0802	0.390	1.775	0.0151	0.0122	180
II-26	1966	Ford	240	6	19,000	58.0	17,266			(Would not meet cycle)				
II-27	1966	Ford	240	6	7,500	45.3	29,666	0.0171	0.0356	0.396	1.280	0.0122	0.0077	125
II-29	1966	Ford	240	6	10,000	51.7	17,300	0.0173	0.0373	0.420	3.010	0.0076	0.0077	180
					II–Avg			0.0264	0.0516	0.464	2.008	0.0134	0.0100	159
III-9	1964	Ford	223	6	14,000	56.7	—	0.0190	0.0301	0.251	1.121	0.0070	—	165.5
III-10	1963	Ford	262	6	16,500	56.7	—	0.0211	0.0386	0.385	1.508	0.0097	—	138.5
III-11	1962	Ford	262	6	16,600	50.0	102,313	0.0327	0.0571	0.375	1.124	0.0071	—	139.0
III-15	1960	Ford	223	6	15,600	55.0	20,729	0.0275	0.0470	0.320	1.530	0.0145	—	126.5
III-17	1961	Ford	292	8	16,000	46.7	74,495	0.0254	0.0467	0.447	2.150	0.0310	—	166.5
III-19	1960	Ford	292	8	16,000	55.0	12,135	0.0256	0.0462	0.576	2.100	0.0329	—	181.5
III-20	1956	Chev	283	8	10,000	53.3	69,000	0.0245	0.0495	0.513	1.255	0.0101	—	184.0
III-21	1960	Chev	235	6	19,500	60.0	69,330	0.0285	0.0662	0.669	2.202	0.0101	—	166.5
III-28	1964	Ford	223	6	16,000	56.7	60,739	0.0277	0.0534	0.352	1.404	0.0106	—	136.5
III-29	1964	Ford	223	6	16,000	56.7	154,940	0.0280	0.0532	0.352	1.950	0.0072	0.0072	162.0
III-30	1962	Ford	223	6	17,000	60.0	82,728	0.0275	0.0516	0.400	7.090	0.0227	0.0298	168.5
III-33	1963	Ford	262	6	19,500	60.0	54,301	0.0319	0.0592	0.445	1.945	0.0299	0.0174	174.5
III-36	1959	IHC	282	6	19,500	56.7	68,376	0.0254	0.0513	0.311	2.565	0.0260	0.0186	178.5
III-40	1959	IHC	282	6	16,500	56.7	58,110	0.0231	0.0471	0.393	1.829	0.0220	0.0207	152.5
III-42	1960	IHC	308	8	10,000	55.0	76	0.0319	0.0625	0.591	1.346	0.0055	0.0111	146.5
					III–Avg			0.0262	0.0505	0.440	1.741	0.01685	0.0179	157.0
IV-12	1966	IHC	345	8	21,000	68.9	2,607	0.0122	0.0235	0.249	1.120	0.0090	—	138.5
IV-13	1966	Chev	327	8	24,000	68.7	4,370	0.0181	0.0302	0.325	2.260	0.0222	—	167.0
IV-14	1966	GMC	305	6	20,000	58.2	16,895	0.0129	0.0266	0.132	1.625	0.0334	—	257.0
IV-15	1966	Chev	327	8	22,000	59.4	1,902	0.0098	0.0200	0.163	1.505	0.0135	—	187.5
IV-21	1965	Dodge	318	8	22,000	62.5	76,200	0.0105	0.0182	0.206	1.935	0.0230	—	157.0
IV-22	1967	Ford	300	6	20,000	69.0	8,657	0.0152	0.0299	0.294	1.469	0.0205	—	189.5
					IV–Avg			0.0145	0.0280	0.241	1.652	0.0206	—	151.0

TABLE 25. AUTOMATIC TRANSMISSION VEHICLES REQUIRING CYCLE ADJUSTMENTS

(All Classes)

Class*	Run No.	Year	Make	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	HC(HR), lb/mi	HC(FIA), lb/mi	CO, lb/mi	CO_2, lb/mi	NO_x, lb/mi	NO, lb/mi	Exh Flow, SCF/mi
III	III-15	1967	Ford	300	6	12,000	57.5	0.0096	0.1234	0.275	1.759	0.0186	–	175.5
	III-16	1959	Ford	292	8	14,000	60.0	0.0206	0.0365	0.390	2.395	0.0077	–	179.5
Avg						13,000	58.75	0.0155	0.0529	0.333	1.576	0.0081	–	176.5
IV	IV-19	1967	IHC	345	8	27,500	46.6	0.0169	0.0375	0.496	2.785	0.0267	–	172.0
	IV-22	1967	IHC	345	8	27,500	46.6	0.0176	0.0396	0.565	2.270	0.0165	–	204.0
	IV-23	1967	IHC	345	8	27,700	46.6	0.0162	0.0392	0.332	2.520	0.0276	–	175.0
	IV-25	1963	Ford	332	8	27,000	46.6	0.0245	0.0626	0.626	1.710	0.0128	–	225.0
	IV-26	1967	IHC	345	8	27,500	46.6	0.0396	0.0734	0.432	2.261	0.0272	–	230.0
	IV-27	1963	Ford	332	8	25,000	55.0	0.0109	0.0364	0.595	1.556	0.0112	–	198.5
	IV-31	1963	Ford	332	8	24,300	57.5	0.0470	0.0812	0.486	2.235	0.0246	–	182.6
	IV-36	1967	IHC	392	8	23,500	59.3	0.0290	0.0368	0.459	2.185	0.0105	–	161.0
	IV-37	1967	IHC	392	8	22,500	59.3	0.0243	0.0478	0.677	2.386	0.0157	–	193.0
	IV-38	1966	IHC	304	8	22,000	62.5	0.0160	0.0356	0.485	1.766	0.0163	0.0156	138.0
	IV-40	1967	IHC	392	8	22,500	55.1	0.0159	0.0132	0.473	2.440	0.0111	0.0177	160.0
	IV-45	1966	Ford	361	8	27,000	49.7	0.0197	0.0568	0.547	2.425	0.0211	0.0201	194.0
	IV-46	1963	Ford	292	8	25,000	59.6	0.0286	0.0381	0.509	3.795	0.0265	0.0314	246.9
Avg						25,340	52.8	0.0235	0.0459	0.505	2.407	0.0240	0.0262	191.6

---

*No Class II automatic transmission equipped trucks tested.

six speed ranges. For further description of cycle adjustments, please refer to the vehicle inspection log sheets in Appendix D. The changes are described as well as the initial accel time through the gears for those vehicles which encountered difficulty.

To summarize the cycle adjustments, it was found that most of the Class II vehicles could operate the experimental cycle satisfactorily though a few were termed "underpowered." A significant number of Class III (manual transmission) vehicles depended on adjustments to the cycle for satisfactory operation. These adjustments, overall, did not appear to have a gross effect on emissions when compared to the emissions of the respective class. The adjustments for the Class III vehicles were mainly to permit satisfactory accel through the gears and to permit normal type driving with the variety of engine-driveline arrangements studied.

On the other hand, the Class IV modifications to the cycle were to permit well-performing automatic transmission units to not exceed the cycle requirements. Contrary to Class III, the Class IV vehicles had little difficulty in performing the cycle. Some vehicles appeared "overpowered" for the Class IV cycle. This was particularly true of the single drive axle truck-tractors which, though rated at 27,000 lb, for instance, are normally coupled to a tandem axle trailer for a combined gross vehicle weight of 58,420 lb (State of Texas). The 16,000-lb inertia and the road load installed in the dynamometer did not adequately stress these types of units and to do so would have required special treatment with a more complicated Class IV cycle.

B. Borderline Truck Emissions Results

During the selection of the baseline trucks, it was evident from the truck statistics (see Section VII. A) that the distinction between Class III and IV, at 19,500 lb GVW, occurred near the peak of the distribution of heavy-duty trucks. Accordingly, depending on truck license or manufacturer license policy a disproportionately large number of trucks could be either a Class III or IV vehicle. As a result, a small group of trucks at or near the borderline between classes were operated under both potentially applicable cycles.

Four trucks with gross vehicle weights of 10,000 lb, the dividing line between Class II and Class III, and four trucks rated at or near 19,500 lb, the borderline between Class III and Class IV, were operated under each of the respective experimental cycles. (Individual inspection sheets are given in Appendix G.) By analyzing the exhaust emissions from both experimental cycles, additional insight as to the applicability of the experimental cycles was obtained.

Shown on Table 26 are the results of the borderline truck study. The Class II-III results are listed first for each vehicle and the difference attributable to the experimental cycle noted. The HC mass emissions for these trucks ranged from 10 to 25 percent higher when the trucks were operated on the Class III cycle. The CO results were also higher when the truck was operated on the Class III cycle. The initial three trucks show a 5 to 10-percent increase while the fourth truck showed a 50-percent increase. The NO_x emissions followed no predictable trend. Overall, the Class II cycle resulted in lower hydrocarbon and CO emissions than the Class III cycle. Airflow was less but NO_x and CO_2, overall, were higher.

The Class III-IV borderline tests indicated that the Class III cycle was more stringent than the Class IV on production of HC and CO and NO_x. Airflow was less during the Class IV than the Class III meaning more throttle opening during the livelier Class III cycle. The HC data ranged from 70 to 90 percent higher with the Class III cycle. The CO emission was also higher (30 to 75 percent) with the Class III cycle. Truck to truck, the effect of cycle on NO_x was variable.

Overall, the emissions difference in both sets of borderline truck experiments indicates the difficulty of classifying the trucks above 6,000 lb GVW into GVW categories. This is dramatically shown by the Class III-IV borderline results. Hydrocarbon production was decreased by almost 50 percent, CO by about 40 percent and NO_x by 50 percent. These effects were due to cycle alone, as the same inertia, 16,000-lb equivalent weight, was employed in both cycles. Coupled to the relatively large number of trucks manufactured at or near 19,500 lb GVW, it appears that such a division would be ill advised.

TABLE 26. EMISSIONS RESULTS OF BORDERLINE VEHICLES OPERATED ON ALTERNATIVE APPLICABLE CYCLES

[illegible]	Year	Make	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Cycle
Class II-III Borderline Results															
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	II III
			Difference III-II												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	II III
			Difference III-II												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	II III
			Difference III-II												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	II III
			Difference III-II												
II Average III Average			Overall Difference					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Class III-IV Borderline Results															
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	III IV
			Difference IV-III												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	III IV
			Difference IV-III												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	III IV
			Difference IV-III												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	III IV
			Difference IV-III												
III Average IV Average			Overall Difference					[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

The Class II-III borderline results were not nearly as different even though different inertias were used (8,000 lb for the Class II and 16,000 lb for the Class III). A possible explanation may be that both Class II and Class III cycles are fairly "lively" in which the schedule is repeated four times (four accels from idle) instead of the more sedate Class IV procedure. In any event, a serious limitation and difficulty would surround experimental cycle applicability to borderline weight vehicles.

IX. SUMMARY AND CONCLUSIONS

The following points summarize the important items of achievement and the key findings of this project:

(1) Three experimental non-constant speed chassis dynamometer test procedures were suitably modified to permit operation of vehicles with gross vehicle weights of 6,000 to 10,000 lb, 10,001 to 19,500 lb, and in excess of 19,500 lb on the SwRI dynamometer. This facility realistically simulated road conditions of power and vehicle inertia.

(2) Using several identical correlation vehicles and the PHS servoproportional sampling apparatus, an adequate correlation with the modified experimental cycles was established with previous road data published by Ethyl Corporation.

(3) Satisfactory correlation of the truck version of the PHS constant volume sampler, designed and prepared as part of this program, was made with the PHS servoproportional sampling method. This confirmed earlier published correlations for the automobile size sampler.

(4) The constant volume sampling system was found to be a useful method for sampling the exhaust of gasoline powered vehicles. The speed and ease with which this sampling system can be employed make this a preferred method for use in obtaining baseline data or survey-type data in which mass emissions are of paramount importance.

(5) Background contamination in the diluent air used by the constant volume system can, under certain conditions, mislead and interfere in the emissions measurements causing higher readings. Alternative methods of compensation were considered and a satisfactory method used throughout this program.

(6) A limited study of the effect of vehicle operation on emissions was conducted. This study indicated that the constant volume sampler, like the servoproportional sampler, is sensitive to changes in vehicle operation, for example, road load.

(7) Results were obtained using the current Federal Heavy-Duty Gasoline Truck Cycle, by both the continuous NDIR sampling and analysis system, and the constant volume technique. As no readily apparent means is available for the expression of emissions measurements on a mass basis for the constant-speed, heavy-duty gasoline truck cycle, no correlation of the two techniques was possible.

(8) On the basis of a small group of vehicles, mass emissions data indicate that the Federal Heavy-Duty Gasoline Truck Cycle did not correlate with the experimental test cycles established to simulate actual vehicle operation.

(9) Approximately 150 trucks and buses of all types were investigated to determine (a) the ability of each vehicle to perform with the respective experimental cycle, (b) each vehicle's contribution of contaminants per mile driven on a mass basis, and (c) the applicability of the cyclic type test procedures in general use.

(10) Baseline exhaust emissions and cycle drivability data were obtained from 135 gasoline-fueled trucks and buses employed in typical, routine use in urban-suburban operation. Because of the wide range and variety of truck usage and available truck engine-driveline arrangements, a significant number of trucks required adjustment to the test procedure. Most of these adjustments were for vehicles which were judged "under-" or "over-" powered or had automatic transmissions which varied from three to six forward speeds.

(11) Vehicle baseline emissions are listed by weight class by a rank-order procedure for each major contaminant: CO, HC, and NO_x. By assigning equal weights to the three contaminants, the total contribution by each vehicle was assessed. Categories of "high," "moderate," and "low" were arbitrarily established.

(12) Using the rank-order categories, an attempt was made to relate engine make, displacement, and cylinder arrangement, age, mileage, type of service, and apparent observed condition to its contribution of contaminants. Only for the weight Class III trucks did a relation appear between the judged engine condition and high and low rankings.

(13) A large amount of base-line data was gained with a group of moving sources heretofore not surveyed. These results should be of importance in future studies of similar or related moving sources.

(14) The emissions from five city buses and six truck-tractors fueled with liquid petroleum gas (LPG) were obtained and compared to other Class IV vehicles fueled with gasoline. The HC and NO_x emissions appeared lower and CO was about the same. The LPG hydrocarbon mass emissions were about the same by NDIR and FID methods. This was not the case with the gasoline engine where the FIA hydrocarbon response was typically 1.8 times higher than NDIR hydrocarbon response on an equivalent ppm C basis. The NDIR instrument for hydrocarbon analysis was sensitive to n-hexane.

(15) The 19,500-lb GVW division between Class III and Class IV appears ill-advised on the basis of manufacturers' output of vehicles and their statistical distribution. The Class III to IV dividing line is near the middle of the hump in the distribution of the heavy-duty gasoline truck population.

(16) Licensing policies of truck users, which ultimately govern how a particular vehicle is loaded and used, do not necessarily follow from that recommended for the basic vehicle without body. Vehicles are often licensed for less gross weight. By adding or changing springs or other minor revisions, a vehicle may be licensed for more pay load weight. The large variety of engines, transmissions, rear axles, springs, number and size of tires, body styles, and wheel bases compounds the problem of determining the proper weight category in which a vehicle should be placed. Depending on the duty cycle, some operators intentionally "under" or "over" power their vehicles for a variety of reasons. All this appears to preclude a simple and rational classification of vehicles and the reduction of classes from three to two would only lessen the problems, not eliminate them.

(17) The use of the three experimental cyclic test procedures appears to have only marginal justification. This was illustrated by the operation of two small groups of borderline weight vehicles on the alternative possible cycles. Based on fairly consistent data, grossly different emissions can result, depending on the cycle employed.

X. RECOMMENDATIONS

Based on the findings of this 18-month study, the following recommendations are offered for consideration.

(1) The advantages of the PHS constant volume sampler appear to far outweigh the background diluent problem. With additional effort, an acceptable method for minimizing, or eliminating, the potential difficulties should be developed so that the system's full potential for mass emission sampling may be realized.

(2) The experimental cycles appear to lack the overall justification required for exhaust emissions measurements from gasoline powered heavy-duty trucks. This does not imply that laboratory simulation of realistic road operation is not practical, only that the immense variety of truck and bus vehicle engine driveline and weight combinations appear to preclude treatment of all vehicles/engines on a gross weight basis. Furthermore, mere reduction in number of weight categories from three to two would only reduce and not eliminate these problems. As a result, it appears that no additional study of the three variable speed experimental cycles is warranted. A simpler, less complicated method which is not based on vehicle gross weight should be considered. This emissions test procedure, however, should demonstrate adequate relationship with actual field road emissions. Such a procedure could take the form of a constant-speed method similar to that described in the Federal Register. Limited tests to date, however, indicate less than adequate correlation of the Federal procedure with vehicle road emissions.

(3) Continued efforts are recommended to (a) obtain mass emissions on a typical road route, (b) investigate their correlation with Federal constant-speed emissions (same vehicles), and (c) modify the current constant-speed method to more adequately relate to road emissions. The PHS constant volume sampler should be used to acquire both road and laboratory data and be compared to the continuous NDIR cart with the overall objective of eventually using only the constant-volume method.

(4) The elimination of the alternative chassis dynamometer constant-speed procedure from the June 4, 1968, Federal Register should be reconsidered. Operation of engines can be readily accomplished by either stationary test bed or chassis dynamometer with equivalent reliability. The chassis dynamometer method, however, precludes the need for removal/installation of engines from vehicles for testing and permits laboratories without expensive all electric stationary dynamometers to convert existing chassis dynamometers at less cost and time. Surveillance testing must be done on chassis dynamometers for simple, periodic acquisition of emissions from a large number of vehicles.

(5) Future efforts should continue to include limited studies of liquid petroleum gas (LPG) fueled vehicles. The apparent absence of many of the hydrocarbons typical of gasoline exhaust warrants additional study and possibly a reassessment of the value of LPG from the basis of photochemical reactivity of exhaust hydrocarbons.

(6) Variations noticed in the NDIR to FIA hydrocarbon values were sufficient to suggest that the total hydrocarbon values by FIA be used in the future as a preferred analysis method. Care must be exercised to minimize oxygen response of the flame and to prevent possible loss of hydrocarbons in the sampling train, etc. The use of diluted, integrated bag samples from the PHS Constant Volume Sampler permits low sample feed to the burner.

(7) With the highly diluted samples of exhaust, occasional difficulties in agreement between the modified Saltzman and NDIR-NDUV analysis for NO_x and NO-NO_2 were experienced.

Accordingly, it is suggested that oxides of nitrogen in the highly diluted samples be measured by the continuous methods. Experience with the NDIR for NO and NDUV for NO_2 has been satisfactory, although the NDIR NO instrument is sensitive to water vapor.

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PUBLICATIONS AS A RESULT OF THIS PROJECT

In addition to this final comprehensive report, the following phase, interim, or special reports were submitted.

Title	Author(s)	Date
Special Status Report No. 1 Covering Road and Chassis Dynamometer Operating Results for One Class III Vehicle and One Class IV Vehicle	Karl J. Springer	August 23, 1967
Special Status Report No. 2 Covering Road and Chassis Dynamometer Operating Results for 1967 Chevrolet C-60 Truck No. C-7613R	Karl J. Springer	January 9, 1968
Preparation of Truck Version PHS Variable Dilution Sampling System	Karl J. Springer Glenn L. Williams	March 1968
Preparations for Acquisition of Baseline Emissions Data from Gasoline Powered Trucks Above 10,000 lb GVW	Karl J. Springer Glenn L. Williams	June 1968
Preparations for Acquisition of Baseline Emissions Data from Gasoline Powered Trucks Between 6,000 lb and 10,000 lb GVW	Karl J. Springer Glenn L. Williams	November 1968

Preparation and publication of two technical papers for wide distribution were also accomplished and are listed below:

Title	Author(s)	Date
"Emissions from Gasoline Powered Trucks Above 10,000 lb GVW Using PHS Proportional Sampling Techniques," Preprint 53C, American Institute of Chemical Engineers	Karl J. Springer Glenn L. Williams Robert W. Olsen Kenneth D. Mills	December 1-5, 1968
"Emissions from 150 Gasoline Powered Trucks Above 6,000 lb GVW Using Experimental Cycles," Under Preparation for January 1970 Annual Meeting of Society of Automotive Engineers	Robert W. Olsen Kenneth D. Mills Karl J. Springer	Under Preparation

APPENDIX A

PREPARATION OF TRUCK VERSION PHS VARIABLE DILUTION SAMPLING SYSTEM

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PREPARATION OF TRUCK VERSION PHS VARIABLE DILUTION SAMPLING SYSTEM

Karl J. Springer
Glenn L. Williams

SPECIAL REPORT
SwRI Project No. 11-2056

Prepared for

Procedures and Emissions Background Development Section
Motor Vehicle Research and Development Program
National Center for Air Pollution Control
U. S. Public Health Service
Ypsilanti, Michigan 48197

March 1968

Approved:

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I. INTRODUCTION

One objective of the work efforts under Modification No. 2 to Contract PH 86-67-72 "A Study of Truck Emissions Powered by Spark Ignited Engines" was to prepare truck version of the Public Health Service variable dilution exhaust sampling system. This report covers the preparation of this sampling system as well as some limited results using this method as compared with proportional sampling system.

In June 1967, the details of the initial prototype variable dilution sampling method were disclosed in an Air Pollution Control Association paper by Messrs. Broering, Werner, and Rose, Reference 1. As mentioned in the Introduction of this paper:

> "With the advent of national standards for the control of automotive exhaust emissions, the need for simple and accurate sampling and analytical techniques for automotive exhaust emission testing has become more critical. Present continuous measurement techniques, provided for in both the Federal and the California Automotive Exhaust Emission Standards, require elaborate sampling and instrumentation. Moreover, the emission levels indicated by the continuous technique used in the present standards are measured on a concentration basis and adjusted by weighted mean air flows, which gives only an indirect general measure of the air pollution potential of a given vehicle. In contrast, when mass-emission levels are used as emission criteria, direct assessment of the air pollution potential of a vehicle can be made."

The principle of operation of the system is the collection and simultaneous dilution of the total exhaust volume from the vehicle with a variable volume of dilution air such that the total mass flow rate of exhaust gas plus diluent air is constant for a given unit of vehicle operation. Consequent measurement of emissions concentration in the exhaust-diluent air mixture would then provide a direct measurement of the mass of contaminants emitted per unit operation of the vehicle. The prototype system consisted of an air to exhaust heat exchanger, a large positive displacement rotary pump as the prime mover to handle the total exhaust from the vehicle, regardless of operating condition, plus substantial diluent air via a large pipe located around the vehicle exhaust pipe. A small sample of the total exhaust of the vehicle, plus the diluent air, after passing through the heat exhanger, was then obtained prior to its entry into the large rotary pump and deposited in a Tedlar* sample bag. This sample was taken at a constant rate through a small rotary positive displacement pump. For mass emission measurements, the samples deposited in the

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*E. I. duPont de Nemours, Inc., and Co.

Tedlar bag were then available for analysis on an integrated, overall, basis. For continuous mode mass emission measurements, samples are available after the sample pump for analysis by standard exhaust measurement techniques.

The variable dilution sampler was shown, in Reference 1, to correlate well with samples obtained via the proportional method for the automobiles studied. By obtaining equally satisfactory results with the variable dilution system, use of the proportional sampler may be minimized. The proportional sampling system, however, remains a powerful tool in the development of dynamometer cycles, acquisition of exhaust samples during operation on closed road courses, and other related sampling requirements.

The prototype PHS variable dilution sampling system was specifically designed to accommodate passenger cars and vehicles which use passenger car type and size power plants. In order to obtain baseline data as described in Modification No. 3 to Contract PH 86-67-72, a truck version of the prototype unit was required capable of handling the exhaust from trucks above 10,000-lb GVW.

II. DISCUSSION OF TRUCK VERSION OF VARIABLE DILUTION SAMPLER

The objective of this portion of the program was to prepare a version of the Public Health Service variable dilution sampling system for use with gasoline powered trucks above 10,000-lb GVW. The approach was to retain the design criteria used in preparation of the prototype, summarized as follows:

(1) Provide for the rapid and accurate determination of the quality and quantity of exhaust being emitted.

(2) Ensure chemical stability.

(3) Permit determination of the mass of contaminants emitted both overall and during individual modes.

To assist in emulating the prototype, duplicate copies of the original purchase orders were furnished by the Technical Officer. In the adaptation of the automotive prototype to truck exhaust, these originally specified items of equipment, hardware, etc., were obtained except where design changes were warranted. The following subsections cover the adaptation and preparation by SwRI of the truck version of this new sampling method.

A. Design Changes

The most important design change required to adapt the automotive prototype for operation with gasoline trucks was to increase the exhaust gas handling and dilution capability of the system. This was necessary to accommodate the two- to threefold increase in exhaust from the larger displacement truck size engines, which are operated on a duty cycle different from automobiles. Because the sampling system is employed with vehicles which undergo a variety of carburetor throttle plate settings and engine speeds, which result in a wide variety of exhaust gas flow rates, only overall average design conditions and estimates of flow could be used to estimate the magnitude of redesign necessary. Using approximate figures, it was reported that the variable dilution system was intended to result in a minimum of 2 parts of diluent air for every part of exhaust flow on an overall average basis, resulting in a dilution level of about 3:1. Based on an average exhaust gas flow rate for the majority of automotive vehicles under present and under development cycles, this meant that an overall gas flow rate including the exhaust and diluent air of approximately 300 cubic feet per minute (cfm) would be necessary for the automotive variable dilution sampler.

Considering the increased exhaust gas flow expected with the larger displacement truck engines operated under a higher airflow duty cycle, a maximum design estimate of approximately three times that employed with the prototype automotive unit was adopted as the upper limit. This meant that the system should be capable of handling about 900 to 1000 cfm of exhaust plus diluent in order to maintain the approximate 3:1 minimum dilution level desired. During this analysis of expected engine exhaust flow rates for the wide variety of truck engine sizes, it was determined that a lower gas handling capability should also be available, if possible. This condition, midway between the automotive and large truck applications, should be able to accommodate engine airflows in the vicinity of 200 cfm, such as the exhaust flow rate from a truck near 10,000-lb GVW weight size. This additional design criterion resulted in maintaining the 3:1 dilution of an overall flow of exhaust plus diluent of about 600 to 650 cfm. Other design changes were minor in nature and basically involved improved instrumentation and packaging of the system to require less floor space, etc.

To handle the increased flow of diluent and exhaust, a Roots-Connersville Model RAI 615 horizontal inlet and outlet rotary blower was selected. For purposes of this report, this blower will be known as the "system blower." A two-speed, three-phase, 208-volt, 60-cycle, constant torque, AC electric motor capable of up to 7.5 hp at 1700 rpm and up to 5 hp at 1150 rpm was selected to direct drive the RAI 615 blower through a suitable Dodge Paraflex coupling. This resulted in the approximate 600 to 650 cfm at the low motor speed of 1150 and 900 to 950 cfm at the high motor speed of 1700 rpm. To maintain both the low and high motor speed, which is essential to the flow parameter of constant volume of gas flow, a three-phase, Y-connected 10.66-kva powerstat was added to maintain constant line voltage. This powerstat resulted in speed stabilization and adjustment by means of input voltage and proved to be an important new feature.

Next, the prototype PHS all stainless steel heat exchanger was studied for its diluted exhaust handling capability and its heat transfer capacity. This proved to be one of the most difficult design portions of the preparation of the truck version in that good basic data regarding peak flow rates and exhaust temperatures were not available, and it was difficult to determine the heat transfer efficiency of the existing prototype unit during cyclic flow and temperature conditions. Because of these limitations and the importance of this item, the heat transfer calculations and the flow capability of the original design were carefully reexamined. It is determined that the majority of the heat contained in the exhaust gas was transferred to the entrained diluent shortly after the exhaust plus diluent entered the flexible stainless pipe but prior to the heat exhanger. The majority of the heat exchange would be through this exhaust to air transfer medium, resulting in an overall higher than ambient diluted exhaust temperature. It was then necessary to analyse the potential of the heat exhanger in reducing the peaks that would normally be expected during acceleration and maximum power conditions which produce maximum flows of exhaust at their maximum temperature. The prototype shell and tube type heat exchanger appeared to have ample heat exchange capacity to smooth out most of the peaks that might be expected during operation. Some design changes were made, however, to permit the threefold increase in diluted exhaust flow without greatly affecting the pressure drop across the heat exchanger. To do this, it was decided to maintain the heat exchanger shell and tube design essentially as originally designed but to increase the diameter of the eighty-one tubes from 3/4- to 1-in. OD. The 304 stainless steel, 20-gauge tubes were retained. The location of the tubes in the tube sheets and the length of the tubes remained the same so that the overall size of the heat exchanger was unchanged. Even though the tubes were enlarged, the residence time of the exhaust in the heat exchanger was decreased. This improved the response of the system but decreased the heat transfer efficiency. To increase the ability of the heat exchanger to reduce the temperature of the diluted exhaust gas, it was determined that a substantially larger cooling air blower be employed. Heat transfer through stainless steel is poor compared to other heat exchanger materials, justifying this decision. A Chicago airfoil fan series "S-Q" with 3-hp, three-phase, 3450-rpm, AC motor was used to belt drive the cooling air through the shell of the exchanger. The mounting flange was redesigned to permit mounting of the larger fan directly on top of the heat exchanger. Additional exit area at the opposite end of the shell was provided to permit the cooling air to escape after passing over the tubes.

The next design change involved driving the small, nickel plated XA-22 series Roots-Connersville rotary sample pump by means of a separate 1/2-hp, three-phase, 1150-rpm, 208-volt motor. This item will be referred to as the "sample pump." A cog belt drive system was used to reduce the motor speed to 760 rpm and obtain the near 4-cfm sample flow rate desired. A number of minor features were incorporated to instrument and control the operation of the sampling system. Bare element, 30-gauge iron-constantan type J thermocouples were installed in six locations, and a suitable, single-point strip chart recorder, Leeds and Northrup Speedomax W was selected for monitoring various temperatures. A Thermo-Electric selector switch was also provided to permit monitoring of any one of six temperatures, continuously. Another design feature was to permit measurement of both the system blower and sample pump speed, rpm, using small sixty-tooth gears and magnetic transducers. To count the number of revolutions that the sample pump turns during an operating cycle, and thereby measure the total flow of sampled exhaust not deposited in the large bag, a modified, sixty-tooth gear was employed. Although not a part of the sampling system, an available SwRI Hewlett-Packard Model 521 electronic counter has been used with success to measure blower and pump rpm and total sample pump revolutions. By means of a microswitch mounted on the three way sample valve, revolution counting begins simultaneously with movement of the valve to the sample position and terminates when the sample period and sample valve are in the vent position. Provision was also made for continuous sampling with suitable Swagelock, quick disconnect, stainless steel, double end type connectors.

Because of the two speed nature and different dilute exhaust flows at the point of exhaust sampling, provision was made to remove and replace the isokinetic probe sized for the high speed, high flow rate system with a smaller sized unit to permit isokinetic sampling at the low speed configuration. The entire sampling system was rearranged to result in a more compact package and consume less floor space than the prototype. In addition, provision was made for a larger sample bag of 4 ft wide × 9 ft high instead of the somewhat smaller bag used with the automotive system. However, in rearranging the system, the objective was to minimize dead space and maximize response while obtaining a representative isokinetically sampled flow. For this reason, the sample probe was located at the end of a fairly long straight section. Instruments, motor controls, and other items in need of attention and operation were placed with the purpose of being functional, as well as attractive and easy to reach.

The final design change made to this sampling system became apparent after the unit was placed into operation with trucks, and samples were obtained. The approximate 950 cfm of diluted exhaust were found to affect the exhaust emissions and engine operation, when the 6 in. flexible stainless steel exhaust sampling pipe was placed over the exhaust pipe of certain vehicles. Location of the 6-in. flexible pipe over the exhaust pipe resulted in a partial vacuum in the exhaust system. Up to 4 in. of water vacuum were measured via a tap located between the muffler and engine during idle and closed throttle deceleration. The design change recommended was to attach a cone to the entrance of the stainless steel flexible pipe to increase the inlet area of the exhaust pipe from 18.8 in^2 (6 in. diameter) to 113 in^2 (12-in. diameter), and thereby reduce the high entrance velocity from 7280 to 1210 ft per min during high speed operation. This design modification effectively eliminated the partial vacuum in the vehicle exhaust system attributable to the high inlet air rate into the exhaust pipe and sampling system. Additional details regarding this modification will be described in a later portion of this report.

B. Description

Shown in Figure 1 is a schematic similar to Figure 1 of Reference 1 of the truck version of the PHS variable dilution sampling system. The collecting duct which is a 15 ft length of 6-in. stainless steel flexible pipe

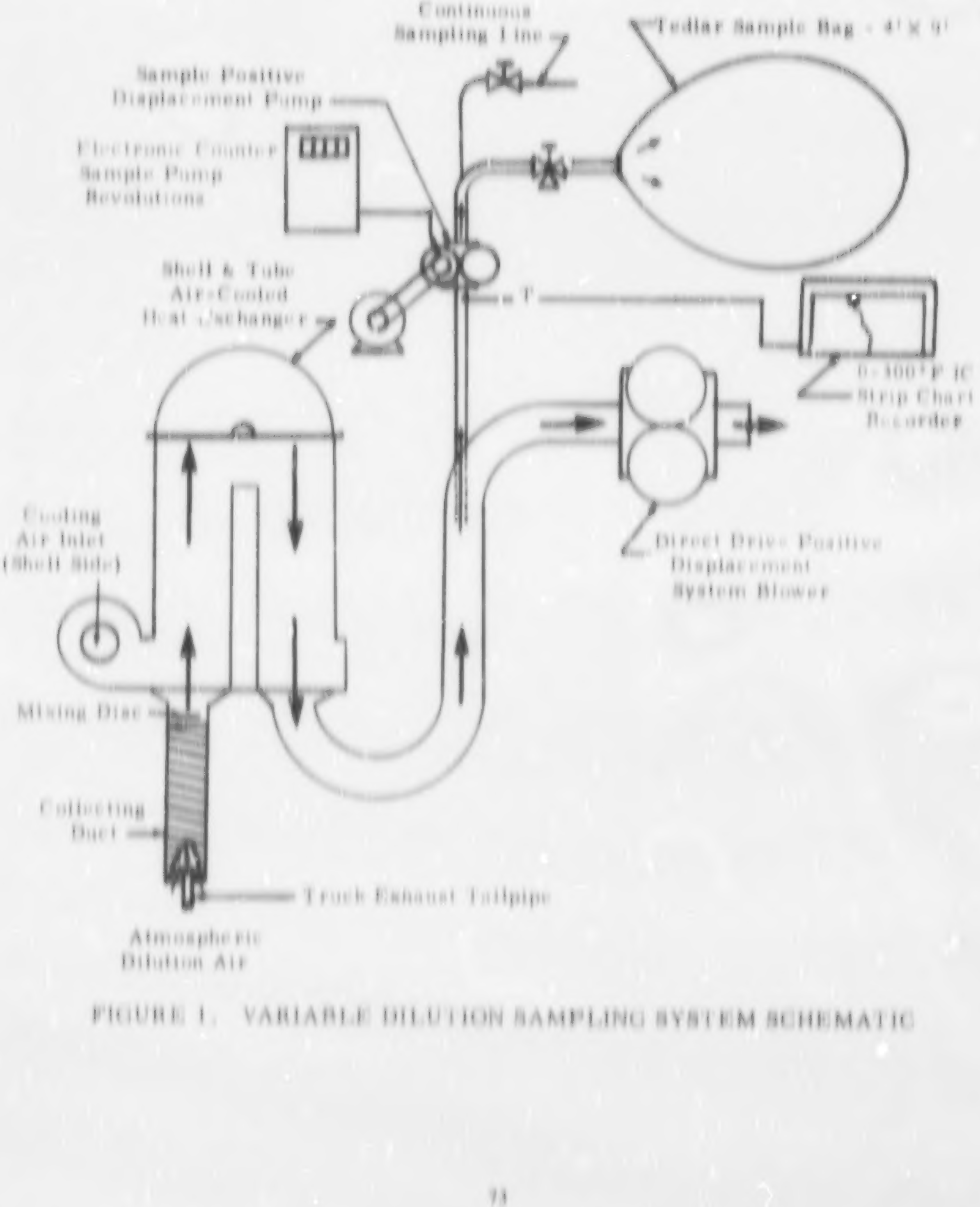
Continuous Sampling Line
Tedlar Sample Bag - 4' X 6'
Sample Positive Displacement Pump
Electronic Counter Sample Pump Revolutions
Shell & Tube Air-Cooled Heat Exchanger
T
0-400°F IC Strip Chart Recorder
Cooling Air Inlet (Shell Side)
Direct Drive Positive Displacement System Blower
Mixing Disc
Collecting Duct
Truck Exhaust Tailpipe
Atmospheric Dilution Air

FIGURE 1. VARIABLE DILUTION SAMPLING SYSTEM SCHEMATIC

is placed over the truck exhaust tailpipe such that the exhaust and diluent air is simultaneously obtained. This combined flow then passes a mixing disc to permit additional mixing of the exhaust and diluent, into an air-to-exhaust heat exchanger of the shell and tube type. The diluted exhaust then is drawn into the direct drive system blower and then into a long flexible exhaust hose for removal from the laboratory. A 5-cfm sample of the diluted, cooled, and well-mixed exhaust is obtained prior to the inlet of the large rotary pump via an isokinetic sample probe located in the center of the 6-in. stainless steel pipe connecting the heat exhanger with the system blower. This sample of diluted exhaust is obtained via the sample pump and deposited in the Tedlar sample bag shown. A suitable electronic counter and strip chart temperature recorder are employed to monitor the sample flow and temperature. Provision is made for continuous sampling when desired at the outlet of the small sample pump. A large cooling air fan is mounted on the heat exchanger.

To further describe the truck version, Figures 2 through 9, photos taken of the completed system, are provided. From Figure 2, designated the front view, it may be seen that the exhaust gas and diluent air mixture enters the sampler cart on the left side via a 6-in. diameter stainless steel flexible pipe which contains a disc to promote turbulent mixing at the entrance to the heat exchanger. The rear view of the sampler cart, shown in Figure 3, more clearly depicts the line of flow of the gaseous mixture. As the gas enters the sampler cart from the 6-in. flexible pipe, it is pulled through the 1-in. OD, 20 gauge stainless steel tubes in the lower half of the heat exhanger, and then routed via the "U" bend to the top half of the unit. The tubes of the heat exchanger can be seen in the lower right corner of the exchanger. This is the exit point of the coolant air. Mounted above the heat exchanger, shown in both Figures 2 and 3, is the cooling fan used to force air through the shell of the heat exchanger. As shown in Figure 3, the diluted and cooled exhaust exits the heat exchanger at the top half of the "U" shaped heat exchanger. The diluted exhaust, Figure 4, the left-end view, travels to the inlet of the system blower via 6-in. schedule 10 type 304 stainless steel pipe. The diluted exhaust then exits the system blower through a 25 ft long, 8-in. diameter flexible hose shown in Figure 4. This black hose is used to remove the diluted exhaust from the test cell and normally terminates outdoors.

The two-speed drive motor, direct connected to the system blower, is shown in Figure 5, a close-up front view of the sampling machine. Additional features of the sampler such as the three-phase powerstat, sixty-tooth gear used to measure the system blower speed, and the electrical system controls, motor starters, etc., may be seen. Figure 6 shows additional details as seen by looking down from the top of the machine. Of importance in this and Figure 7 is the location of the sample probe and its relationship to the straight piece of 6-in. stainless steel pipe interconnecting the outlet of the heat exchanger and the inlet of the system blower. A

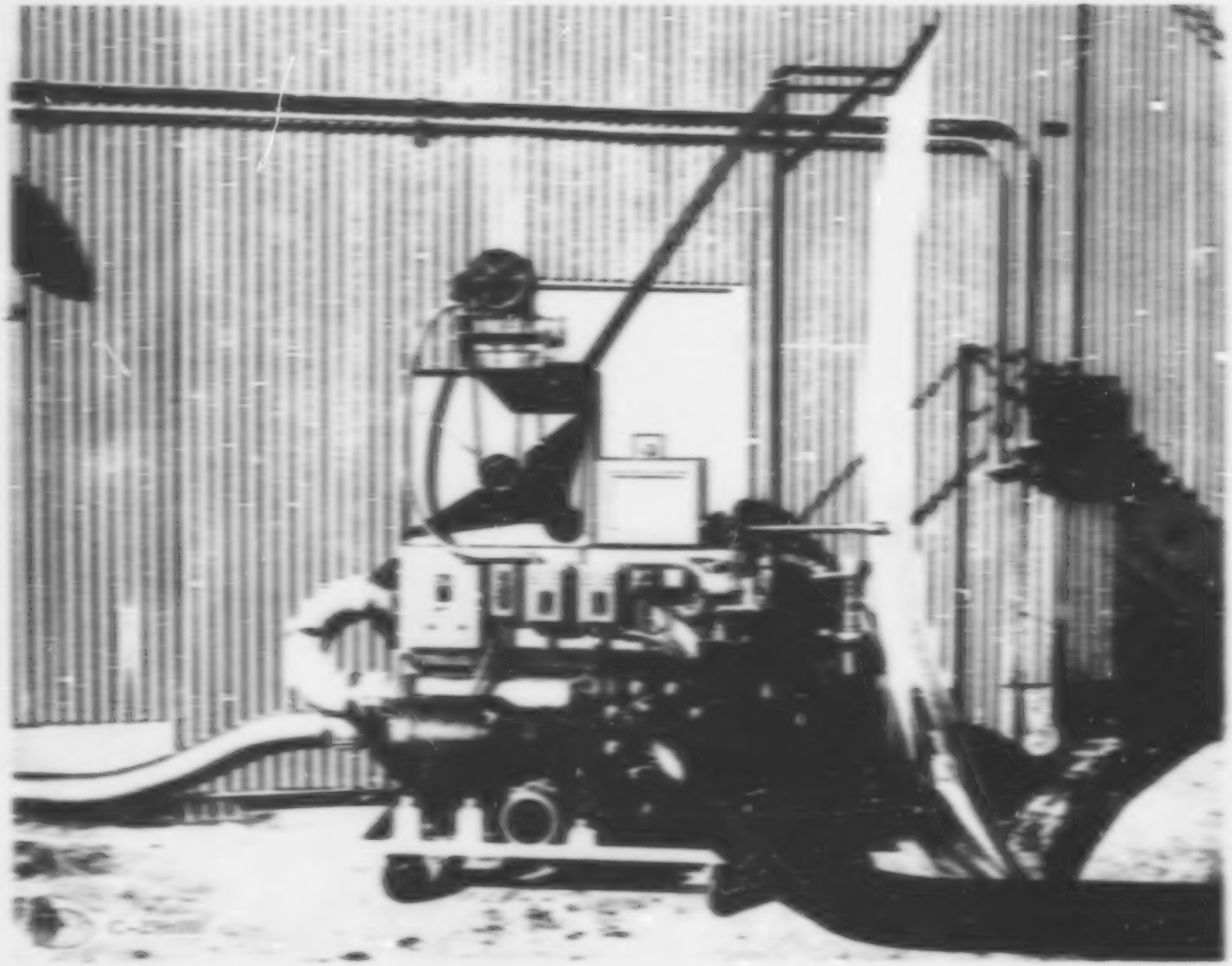

FIGURE 2. VARIABLE DILUTION SAMPLER - FRONT VIEW

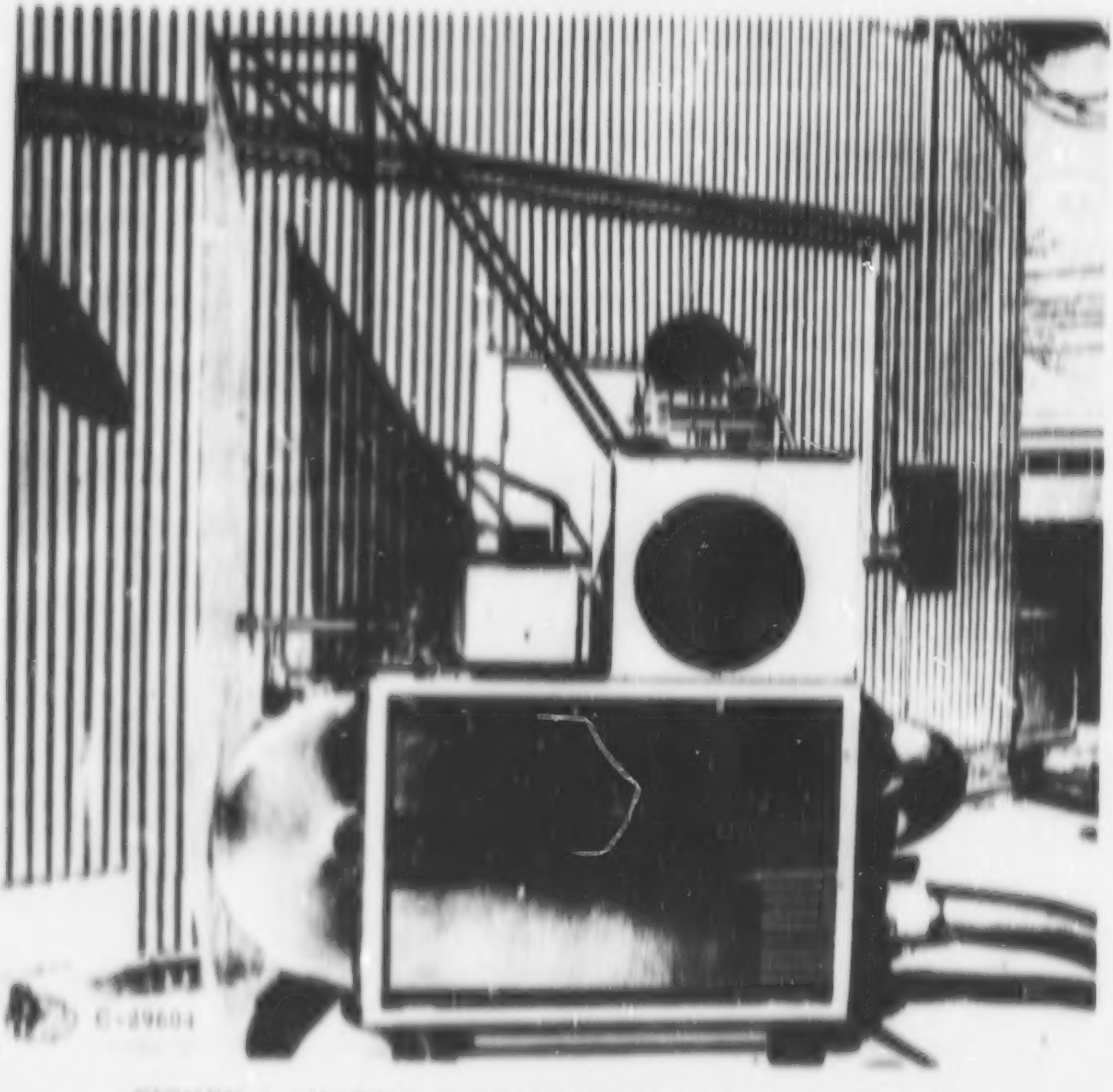

FIGURE 3. VARIABLE DILUTION SAMPLER - REAR VIEW

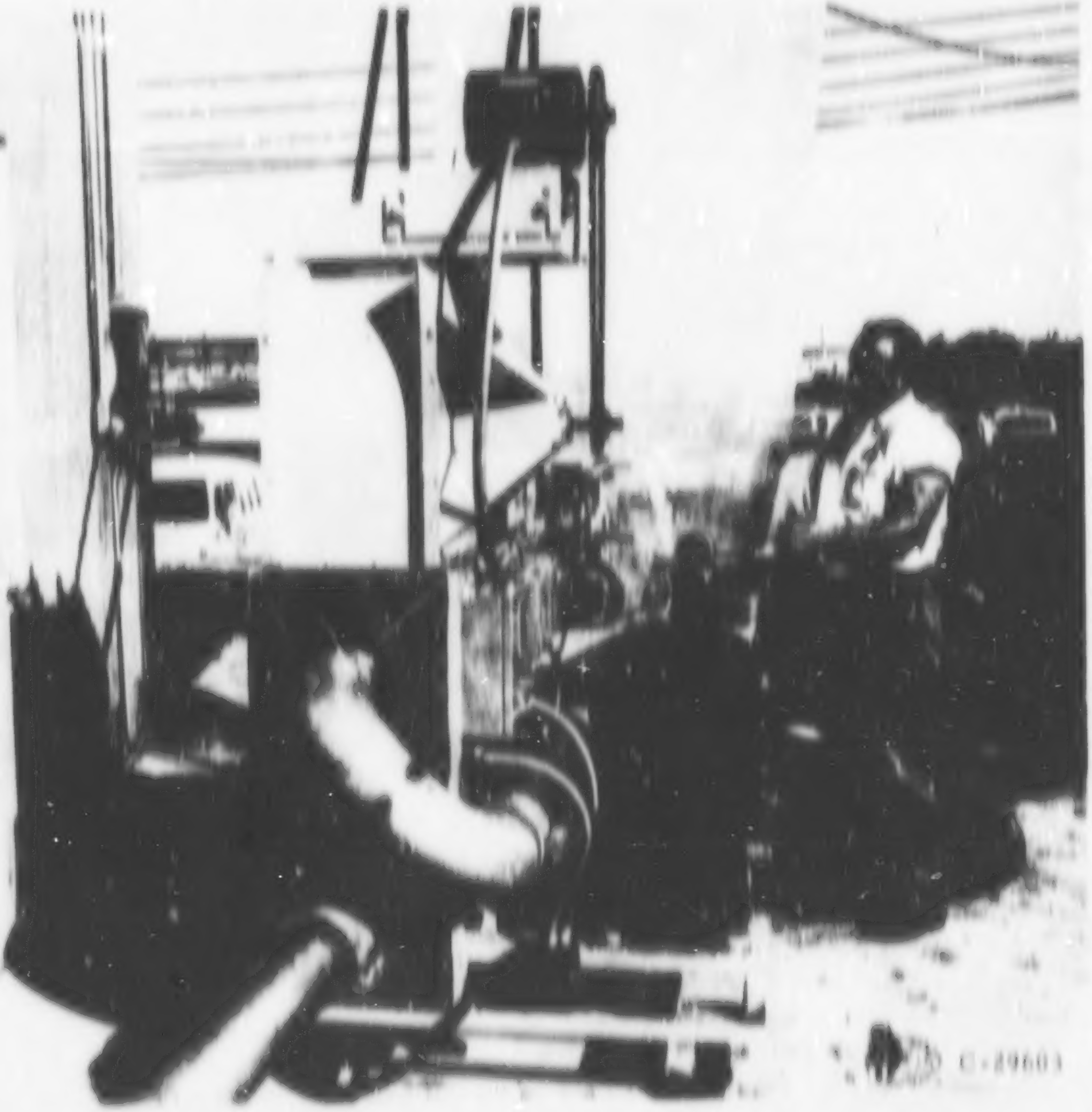

FIGURE 4. VARIABLE DILUTION SAMPLER - LEFT END VIEW

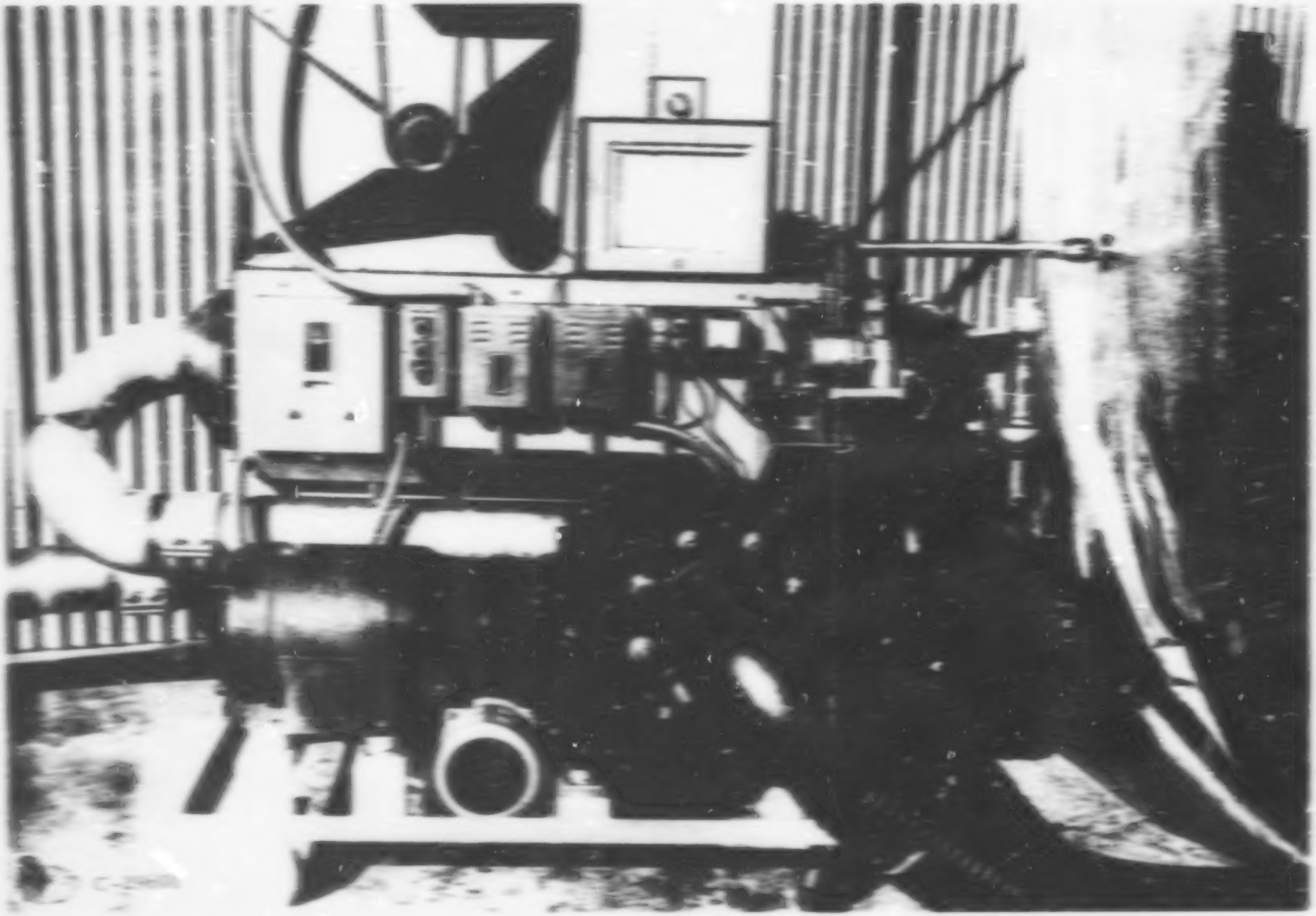

FIGURE 5. VARIABLE DILUTION SAMPLER - CLOSE FRONT VIEW

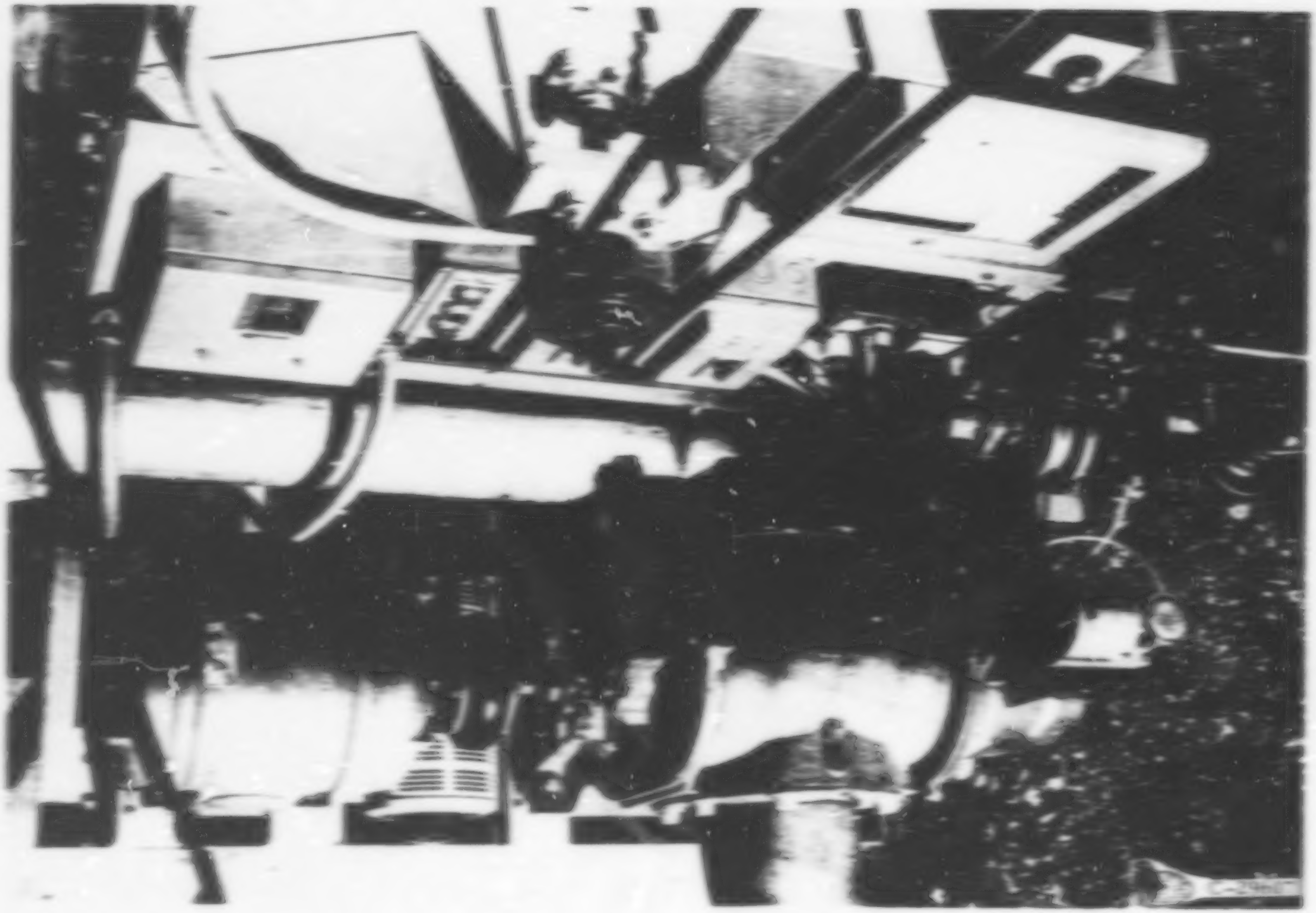

FIGURE 6. VARIABLE DILUTION SAMPLER - TOP VIEW

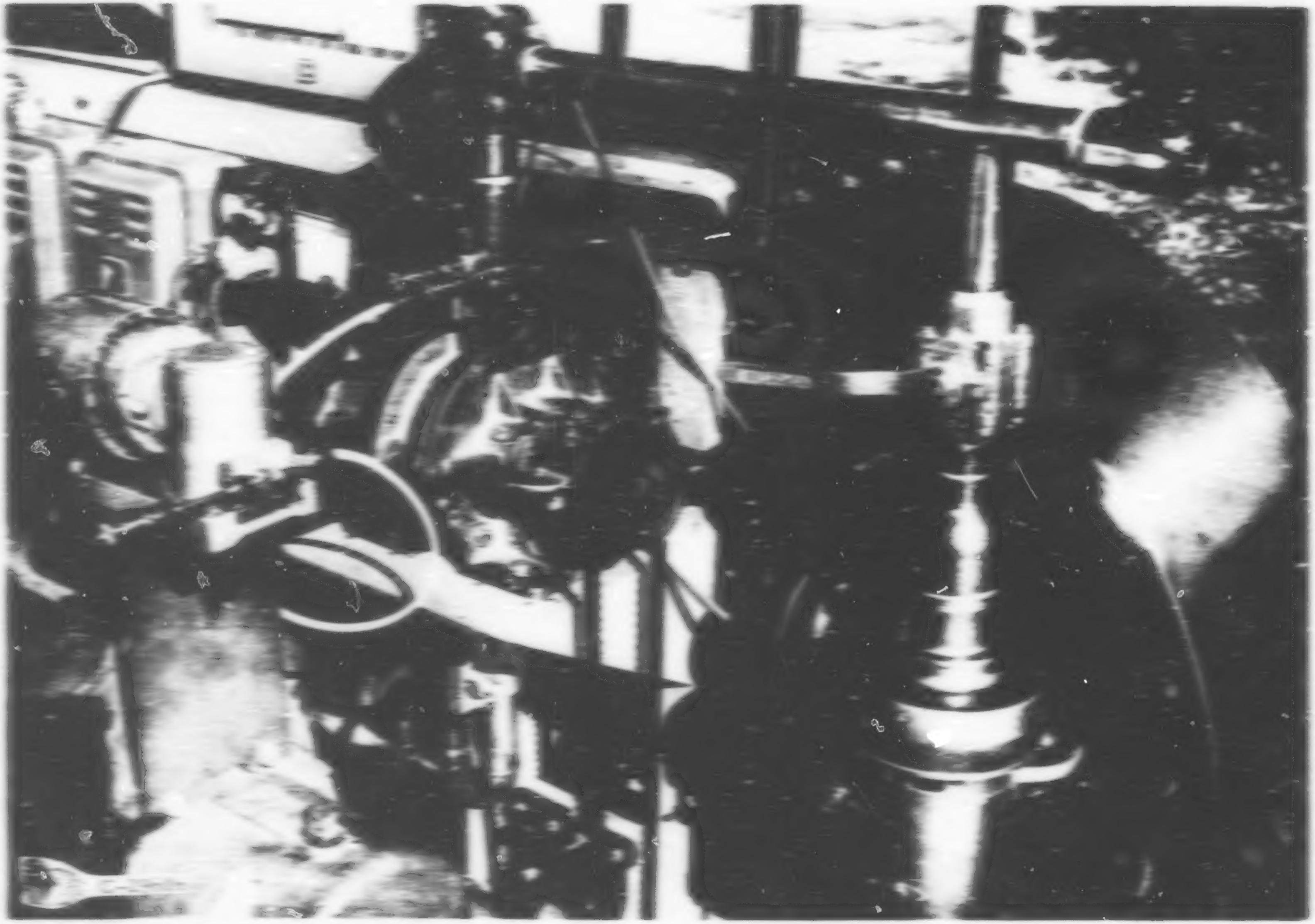

FIGURE 7. VARIABLE DILUTION SAMPLER - 1-IN. ID SAMPLE LINE, CLOSE-UP

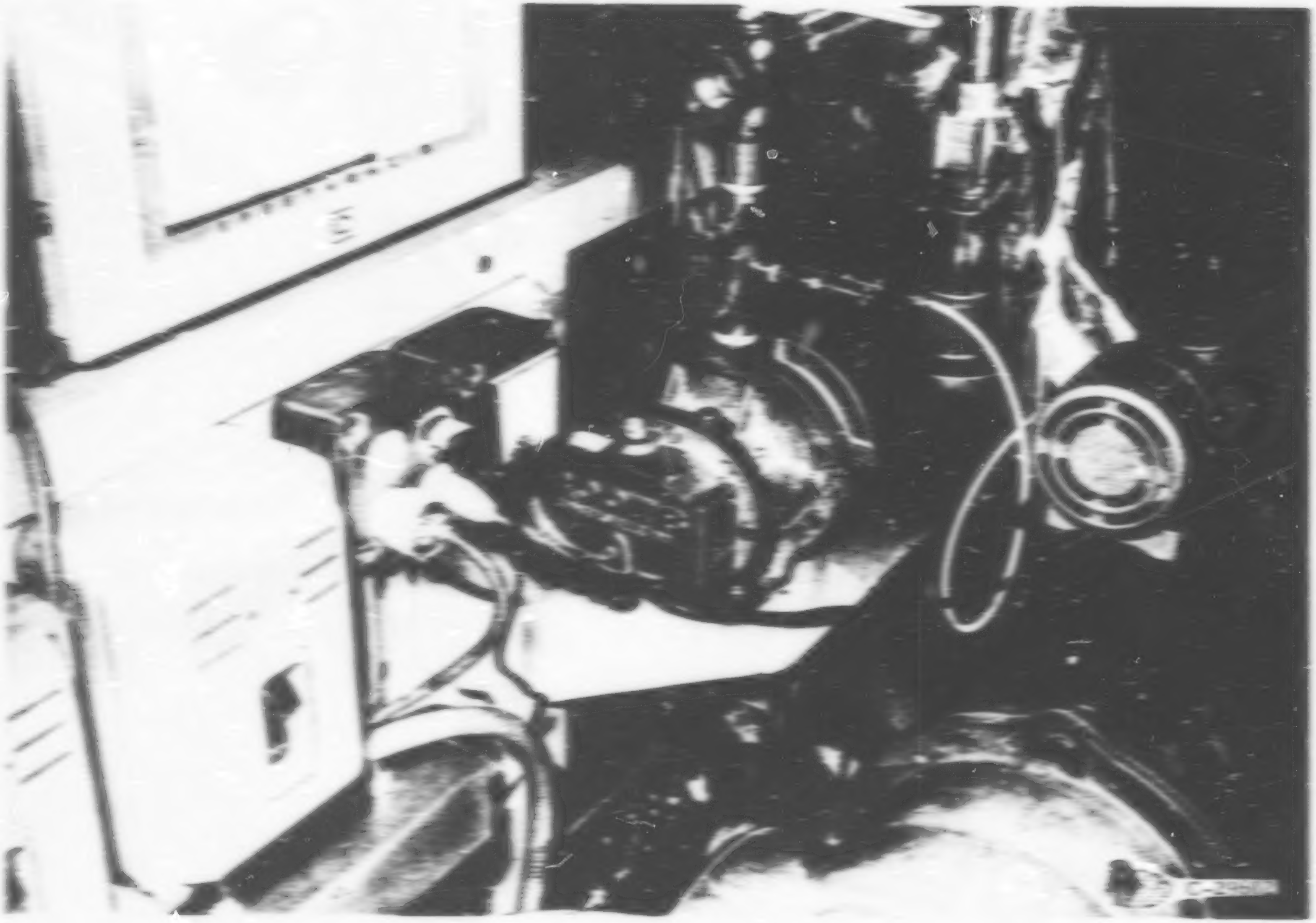

FIGURE 8. VARIABLE DILUTION SAMPLER - CLOSE-UP OF SAMPLE PUMPS

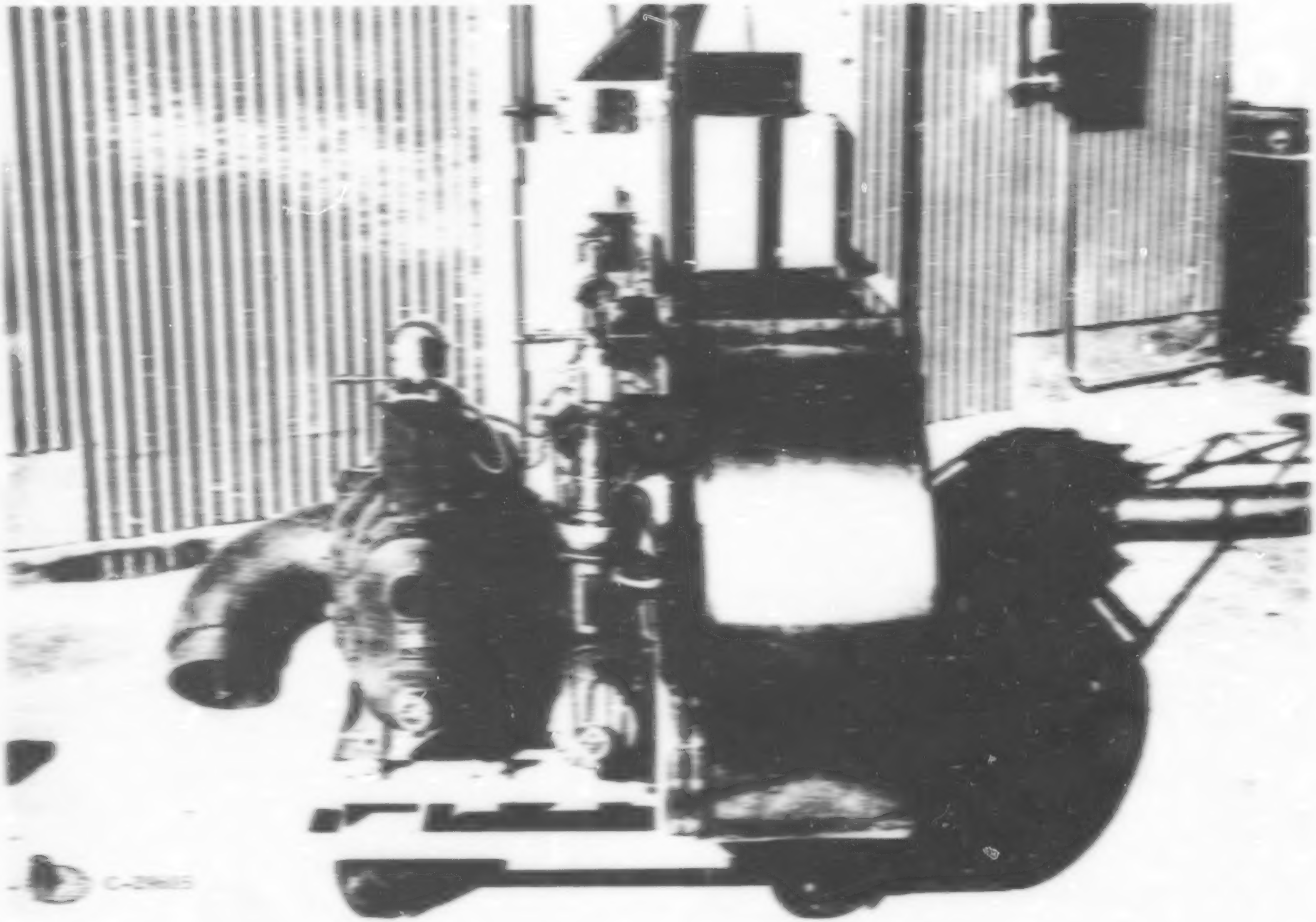

FIGURE 9. VARIABLE DILUTION SAMPLER - RIGHT END VIEW

knurled nut and Viton A O-ring assembly is employed to permit the sample probe, made from 1-in. stainless steel pipe, to be inserted and directed into the center of the straight section of 6-in. pipe. Not shown is the specially machined, stainless, isokinetic probe tip tightened on the end of the 1-in. probe. The threaded design feature permits replacement of the probe tip to permit isokinetic sampling, regardless of the system blower speed and dilute exhaust flow and velocity. Also shown in Figure 7 is the specially prepared sample pump. This pump was nickel plated inside and out and the shaft seals replaced with the Teflon* impregnated Garlock packing specified. The sample obtained via this pump was deposited in the 4 × 9-ft Tedlar bag illustrated in Figures 2, 4, and 5. As shown in Figure 7, the dilute exhaust gas sample enters the pump from the bottom and discharges vertically at the top through a three-way stainless steel valve and then into the sample bag. The speed and sample flow rate through the small gas sampling pump may be varied by replacement of the pump and motor pulley with units of varying numbers of teeth. A number of other pulleys, not shown, are supplied for this purpose.

A sixty-tooth gear and suitable magnetic pickup are shown mounted adjacent to the cog belt pulley and motor drive arrangement to permit measurement of the small pump speed. Once this speed was established, the sixty-tooth gear is replaced with a solid disc with a single hole drilled into the surface. The magnetic pickup now becomes a revolution counter such that the electronic counter may accumulate the total number of revolutions during a particular length of test cycle time. This system is routinely used in operation. Additional details of this part of the system may be seen in Figure 8, particularly the small diaphragm type Dynapump fitted with Viton A diaphragm and check valves. The Dynapump serves to transfer the diluted exhaust sample held in the large Tedlar bag to a small transfer bag for consequent analysis by standard instrument techniques. The gas is transferred via 1/4-in. stainless steel tubing connected to the large sample bag 24 in. above the sample inlet to the bag as shown in Figures 2 and 3.

The final photograph describing the variable dilution sampling system is Figure 9, the right-end view. Located inside of the 1-in. diameter stainless steel Kamlok bag quick-disconnect fitting is a thin stainless steel disc with a drilled opening. The use of this item will be discussed in the calibration section of this report. In operation, the Clements Cadillac suction pump, shown between the heat exchanger and system blower in Figure 9 and also shown below the aluminum two-way valve in Figure 7, is used to evacuate the large sample bag. Once this is accomplished, the three-way stainless steel valve, shown in Figures 7 and 8, directly above the sample pump is utilized to divert the sample stream into the large bag. The Leeds and Northrup Speedomax W single-pen temperature indicator-recorder is shown located over the heat exchanger in Figures 5, 8, and 9. Shown in Figure 5 is the six-position Thermo-Electric selector switch to permit any one of the following:

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*E. I. duPont de Nemours, Inc., and Co.

(1) Diluted gas temperature at inlet to heat exchanger.

(2) Diluted exhaust gas temperature at inlet to system blower.

(3) Outlet gas temperature from system blower.

(4) Diluted exhaust gas sample temperature at inlet to sample pump.

(5) Outlet sample gas temperature from sample pump.

(6) Ambient temperature near entrance to cooling air fan.

Close examination of the photographs will illustrate the location of these thermocouples, as well as static pressure tap locations for measurement of performance and for use in calibration.

C. Calibration

Calibration was the most important step in the preparation of the truck version of the PHS variable dilution sampler. The inherent simplicity in application and operation of this type of sampling system is predicated on a careful and accurate calibration. To analyze and compute emissions from samples obtained by this technique requires precise knowledge of the mass of exhaust handled by both the system blower and the sample pump. The temperature and pressure of the dilute exhaust, as well as the speed of rotation of both the blower and pump, affect the mass flow of dilute exhaust. These parameters must either be adequately controlled or measured for consequent use in computations.

As with the prototype automotive system, the gas pressure and pressure drop across the blower and pump and their speed of rotation were the parameters susceptible of control within acceptable limits. The temperature of the inlet gas to these units, although tempered by the heat exchanger, would not be adequately controlled to a given level, and therefore would have to be measured and used to correct for its effect on mass flow. Using guidelines and advice given by the designers and developers of the prototype, the calibration consisted of establishing speed and pressure drop parameters capable of control and which could be expected to be reasonably constant. The procedure used was to operate the entire system (high system blower speed) and measure the resulting pressure drop first across the system blower and then across the sample pump while measuring the total throughput of air. The approach consisted of loading the system blower and drive motor to obtain the desired throughput of gas, yet maintain stable speed and blower operation for a given blower inlet temperature. The inside diameter of the mixing disc, located at the inlet to the heat exchanger, was varied to permit investigation of a variety of blower speeds and pressure drops. This variation of operating parameters resulted in an optimum pressure drop across the system blower of 16.4 in. of water at 80°F inlet temperature. Once the mixing disc ID of 4.873 in. was established, the same procedure was followed to establish the optimum set of operating conditions for the low speed configuration. This consisted of maintaining the same pressure drop determined for the high speed configuration of 16.4 in. H_2O by decreasing the ID of the inlet mixing disc to 3.146 inches.

Concurrent with establishing the pressure drop and inlet orifice inside diameter sizes for the low and high speed system blower capabilities, the sample pump was also investigated to establish a stable operating speed and load. As with the system blower, a small restriction in the form of a thin disc with a drilled hole was used to maintain a pressure drop conducive to stable pump operation and provide close to 4 cfm of sample. The procedure was to prepare the thin drilled disc for suitable operation of the sample pump during the high speed system configuration while measuring the sample flow rate and pressure drop. The resulting sample pump rpm was 760 rpm, with a pressure drop of 16.9 in. H_2O at 80°F inlet temperature. Using the same rpm and loading disc, the pressure drop across the sample pump was found to be 17.5 in. H_2O at 80°F inlet temperature when the system was operated at low speed.

To measure the flow rate of diluted exhaust gas, a 10-ft long ASME test section made from 6-in. Schedule 10 pipe was used. A thin plate orifice was mounted between flanges located 6-1/2 ft from the inlet of the test section. Flange tap type static pressure taps located 1 in. up stream and downstream of the nearer face of the 1/8-in. thick orifice plate were employed. This test section, along with the procedures used to calculate the flow rate through the orifice, was as specified in the Flowmeter Computation Handbook of the ASME Research Committee of Fluid Meters (Ref. 2). The test section orifice inside diameter was machined to produce the same constant pressure of 16.4 in. H_2O across the system blower with the mixing orifice located at the inlet to the heat exchanger, removed. In effect, the ASME test section, connected to the inlet of the heat exchanger by means of the 15-ft long 6-in. diameter stainless steel flexible pipe, was designed to simulate the effect of the mixing orifice insofar as pressure drop, inlet pressure, and speed of the system blower was concerned. A Precision wet test meter capable of up to 100 cu ft/hr capacity was utilized to measure the flow rate of dilute exhaust sample handled by the sample pump. The outlet gas from this pump was directed into the Tedlar sample bag for a 5-min period. The sample bag contents were then measured by a large wet test meter by counting the revolutions until the bag was evacuated. The small diaphragm pump, placed between the bag and meter, was used to transfer and evacuate the bag contents.

Using the operating speeds and pressure drops determined during the exploratory studies and the measurement methods previously described, calibration of the system was conducted. Following the procedure used in the automotive prototype, curves were established relating flow of the system blower or sample pump to its inlet temperature. For the truck version, the inlet temperature to the system blower and to the sample pump were basically identical, within 1°F of one another. Listed in Table I are the results of the flow calibration of the truck version variable dilution sampling system. The low speed results are listed first, with the system blower operated at 1150 rpm, with the 1.146-in. ID inlet mixing orifice and the 0.490-in. ID isokinetic sample probe installed. The high speed results are then listed for the system blower operated at 1700 rpm, with the 4.871-in. ID mixing orifice and 0.402-in. isokinetic probe tip employed. The inlet temperature into the blower-pump (essentially the same under all conditions investigated) was varied by heating the air at the inlet to the ASME test section. Calibration data were first obtained with an oxy-acetylene welding torch heat source and then repeated using actual vehicle exhaust. The values shown are actual flows in cfm at pressure and temperature conditions as measured at the inlet to the blower pump. These actual flows for both the system blower and sample pump were then added to obtain the total sample system throughput. As with the automotive calibration, the actual cfm were corrected to standard flowing conditions defined as 68°F and 14.7 psia.

Shown in Figures 10 and 11 are plots of the actual cfm of gas handled by the system blower and sample pump over an inlet temperature range of 60° to 110°F for low speed, 1150-rpm system operation. When these two flows are combined and computed in terms of standard conditions, the result is a linear decrease in flow scfm, with an increase in flowing temperature (pressure constant) per Figure 12. With the flow in standard or scfm terms, the mass flow of total exhaust and diluent can be obtained by simply measuring the inlet temperature to the blower or pump. Knowing the inlet temperature, Figure 13 may be used as the system mass flow calibration curve in computing mass emissions. A description of the computation procedure is included in a later section. Figures 14, 15, and 16 are plots of the flow data versus temperature obtained during the high speed system calibration. Figures 14 and 15 show the linear relationship of actual flow, in terms of the inlet pressure and temperature to the system blower and sample pump. Figure 15 shows the combined total flow rate, in terms of scfm at 14.7 psia and 68°F, for the high speed configuration. As with Figure 12, this curve is the calibration curve used in computing mass flow and mass emissions.

TABLE 1. FLOW CALIBRATION OF TRUCK VERSION OF PHS VARIABLE DILUTION SAMPLING SYSTEM

Measurement Method

System Blower: 10-ft long, 6-in. diameter ASME test section thin plate orifice located before the 6-in. diameter flex pipe. Mixing baffle removed.

Sample Pump: Precision wet test meter and diaphragm pump exhausting contents from sample bag.

System Blower Speed, rpm	Temperature Inlet to Blower Pump, °F	System Blower* Flow, cfm	Sample Pump* Flow, cfm	Total Sampler* Flow, cfm	Total Sampler† Flow, scfm
1120 (low)	60	641.02	3.98	645	660
	70	644.92	4.06	649	651
	80	650.86	4.14	655	644
	90	659.79	4.21	664	634
	100	669.71	4.29	674	621
	110	678.60	4.40	683	615
1700 (high)	60	968.86	4.14	973	995
	70	974.83	4.17	979	978
	80	989.72	4.23	994	975
	90	1005.65	4.35	1010	970
	100	1020.61	4.39	1025	961
	110	1035.54	4.46	1040	944

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*Cfm is actual cfm for the blower-pump actual inlet pressure and temperature conditions.

†Scfm is cfm corrected to standard conditions of 68°F and 14.7 psia.

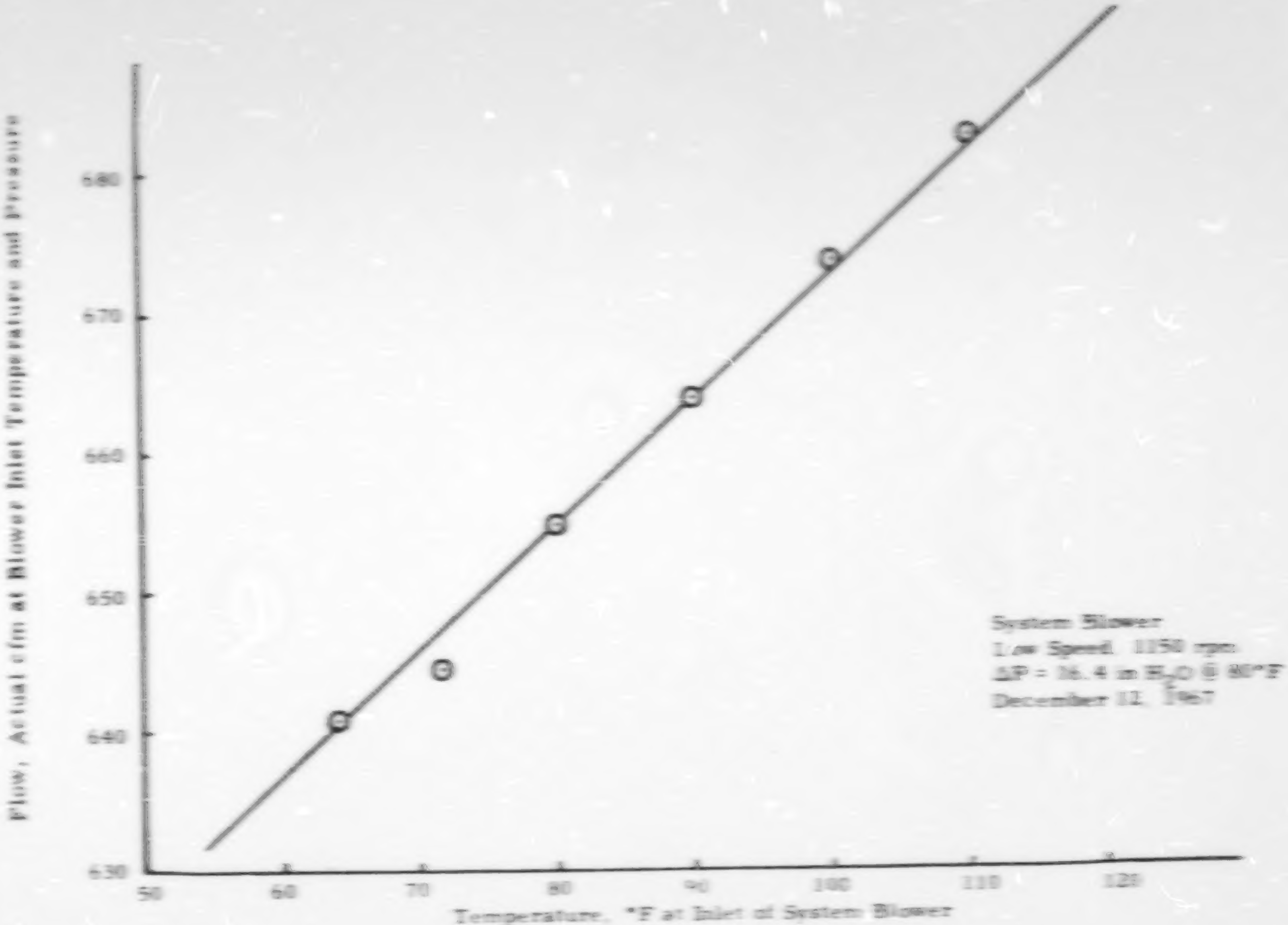
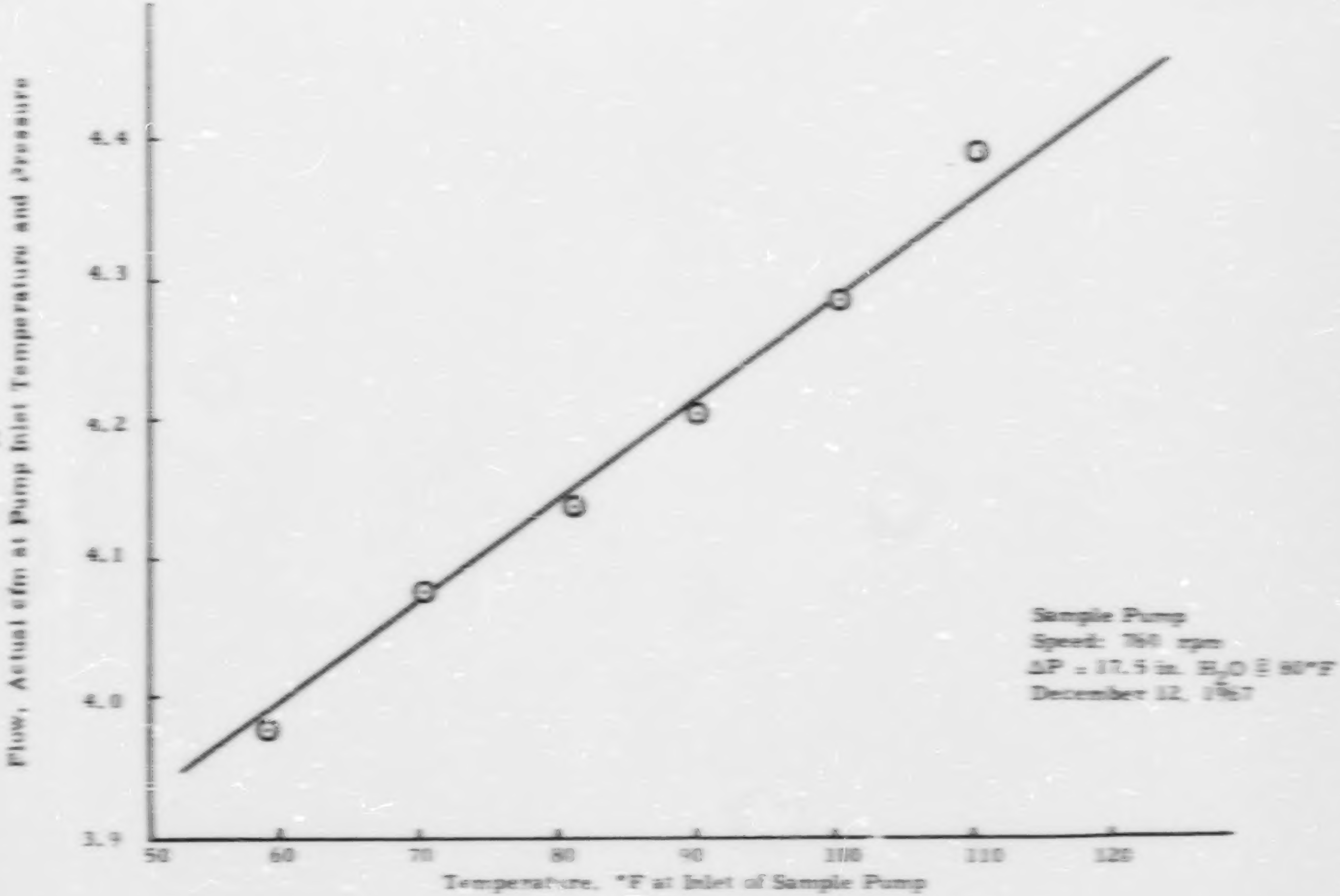
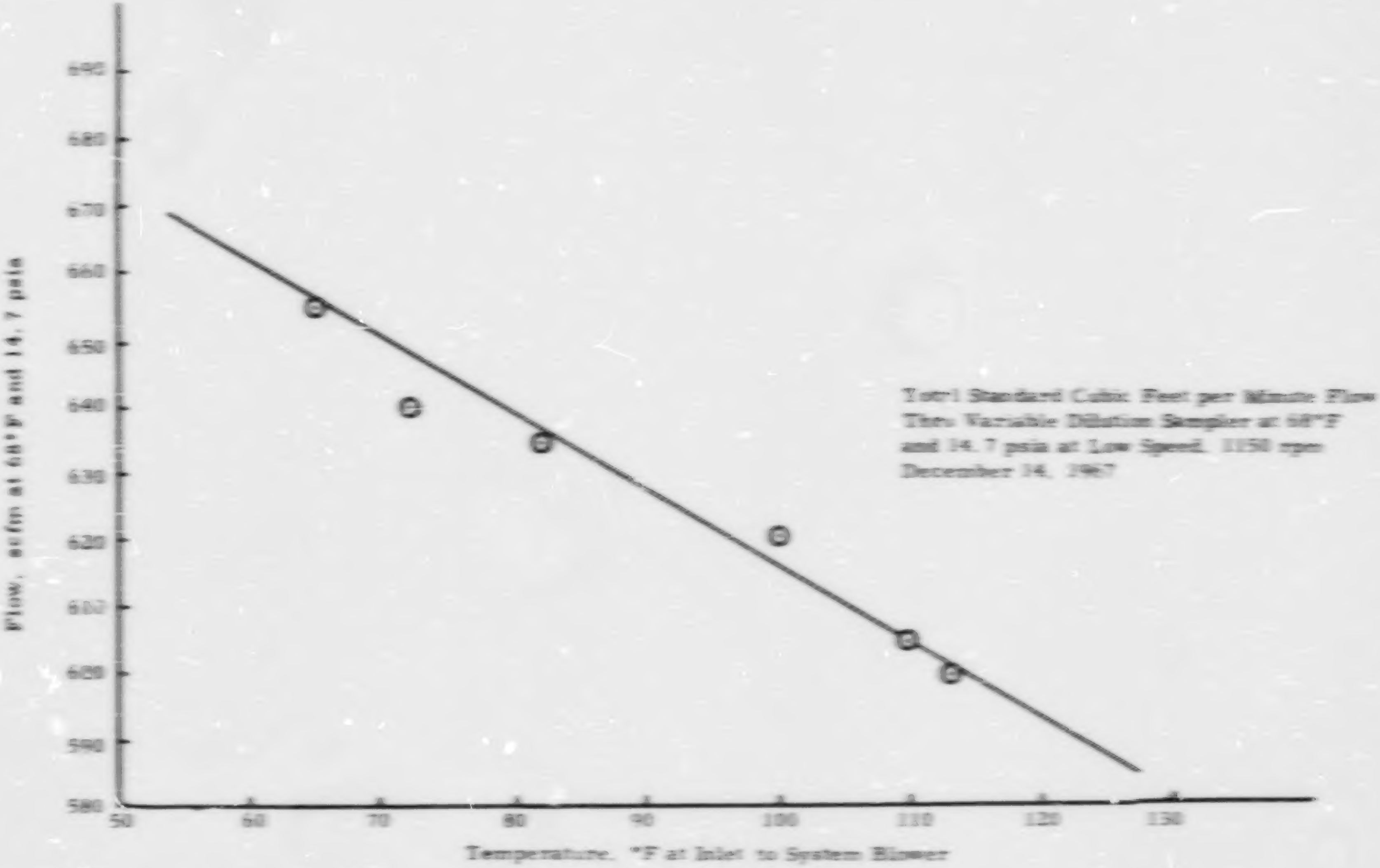


FIGURE 10. FLOW CALIBRATION OF SYSTEM BLOWER
During Low Speed, 1150-rpm, Operation of System Blower



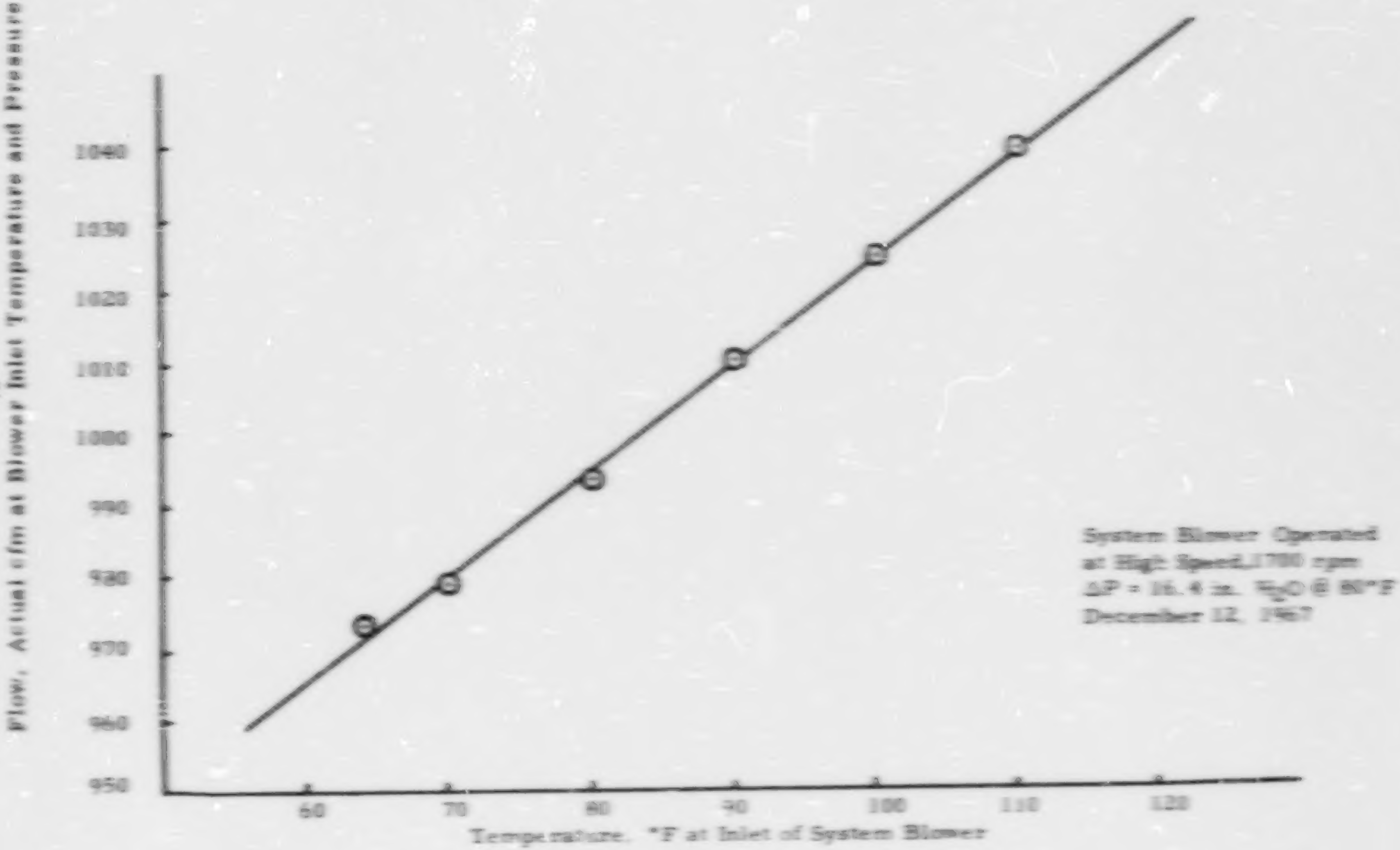
Sample Pump
Speed: 760 rpm
ΔP = 17.5 in. H_2O @ 60°F
December 12, 1967

FIGURE 11. SAMPLE FLOW CALIBRATION OF SAMPLE PUMP
During Low Speed, 1150-rpm, Operation of System Blower



Total Standard Cubic Feet per Minute Flow Thru Variable Dilution Sampler at 68°F and 14.7 psia at Low Speed, 1150 rpm December 14, 1967

FIGURE 12. STANDARD FLOW CALIBRATION OF SYSTEM BLOWER
(Low Speed, 1150-rpm, Configuration)



System Blower Operated
at High Speed,1700 rpm
ΔP = 16.4 in. H_2O @ 80°F
December 12, 1967

FIGURE 13. FLOW CALIBRATION OF SYSTEM BLOWER
During High Speed, 1700-rpm, Operation of System Blower

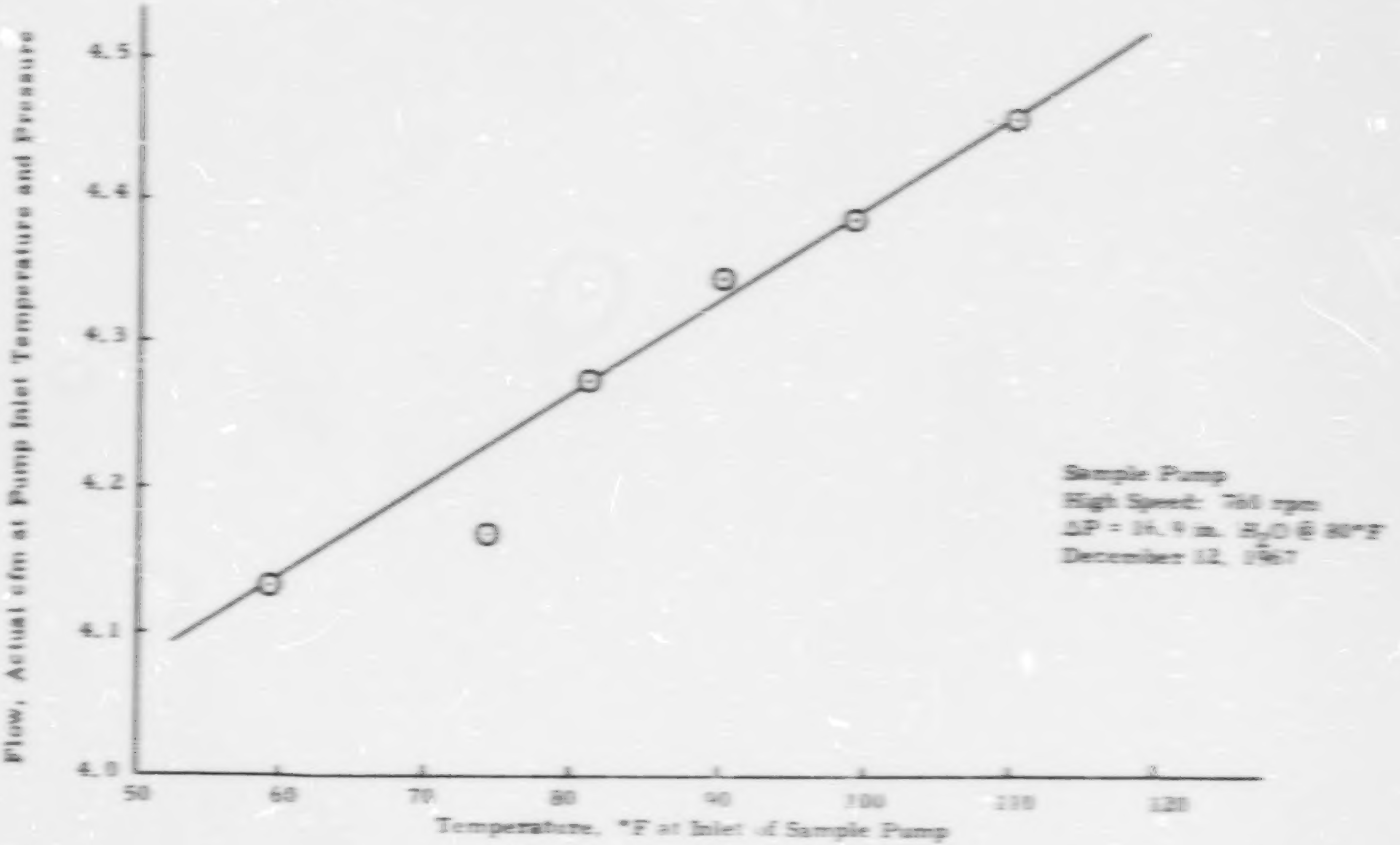


FIGURE 14. SAMPLE FLOW CALIBRATION OF SAMPLE PUMP
During High Speed, 1700-rpm, Operation of System Blower

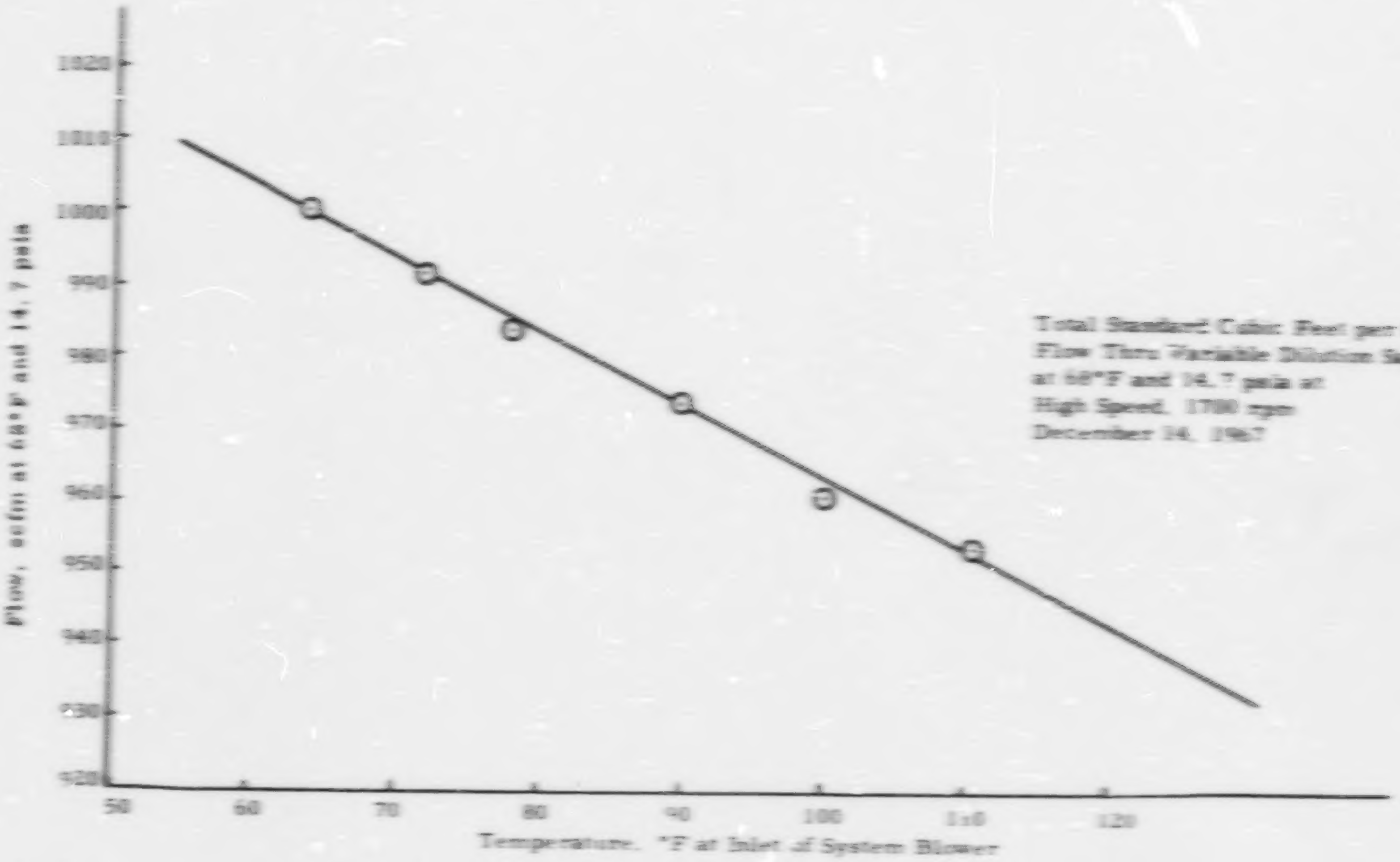


FIGURE 15. STANDARD FLOW CALIBRATION OF SYSTEM BLOWER
(High Speed, 1700-rpm, Configuration)

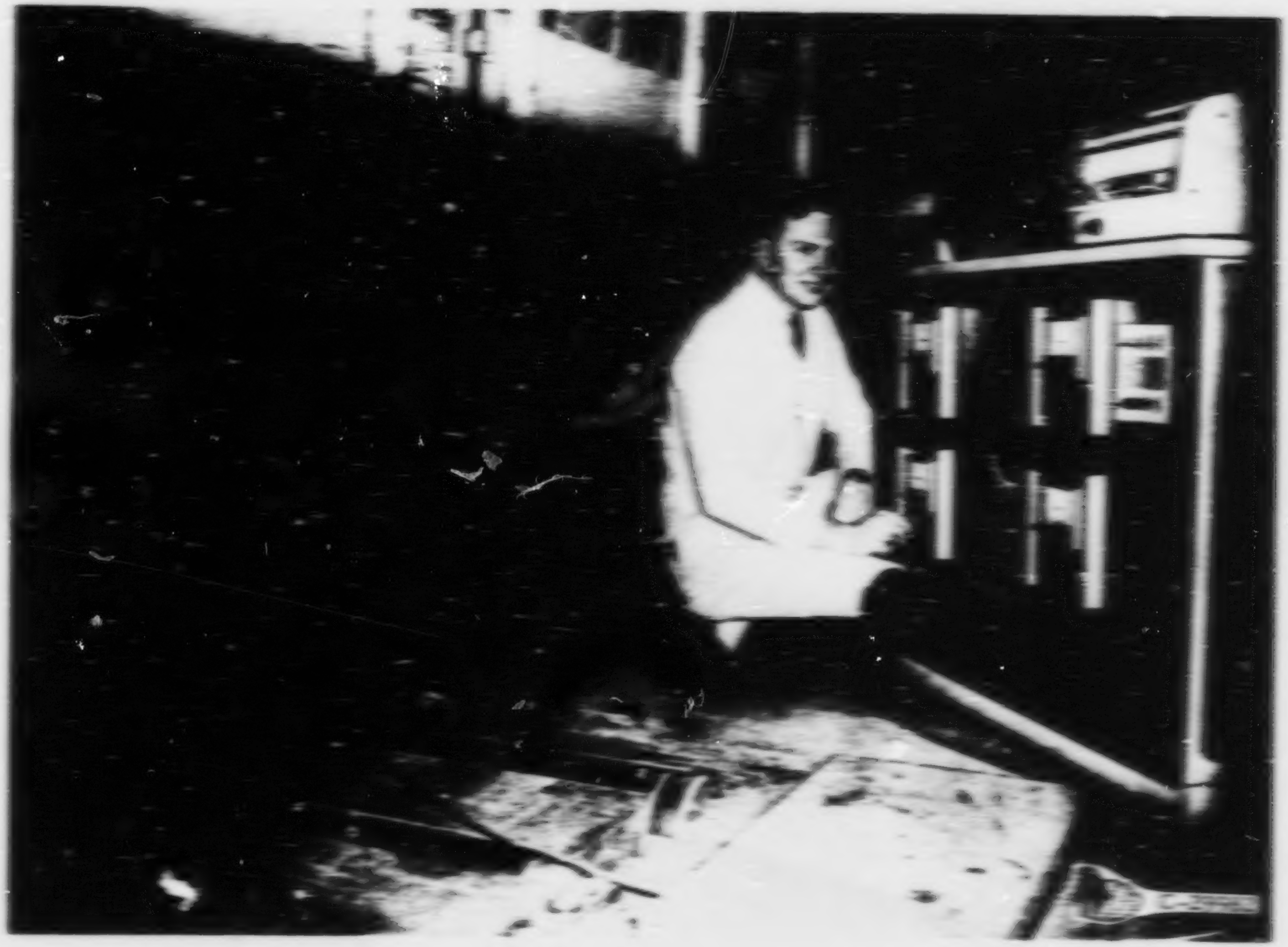


FIGURE 16. VARIABLE DILUTION SAMPLER INTAKE PIPE WITHOUT CONE

While acquiring the calibration data, a brief study was made as to the effect of power supply variations in line voltage on the resulting system blower speed and pressure drop. Making use of the three-phase powerstat to vary the voltage applied to the two-speed motor drive for the system blower, a minor variation in pressure drop and small variation in blower speed were obtained. The following pressure drops and blower speeds were measured with the mixing orifice installed.

System Blower Motor Voltage, volts	Low Speed System Blower		High Speed System Blower	
	ΔP, in H_2O	Speed, rpm	ΔP, in H_2O	Speed, rpm
200	16.4	1135	16.2	1672
210	16.45	1143	16.3	1685
220	16.50	1149	16.4	1697
230	16.60	1154	16.5	1705

As indicated above, the variation in line voltage had little effect on the low speed system performance but had a significant effect on the speed of rotation, and cfm, throughput when the motor was operated at high speed. Since the powerstat permits manual adjustment of the input voltage regardless of voltage supply, this variable may be easily controlled and maintained at 220 volts.

After operating the variable dilution sampler in a correlation study, it was found that the approximate 950 total scfm flow rate of the variable dilution sampler affected the exhaust emission when the flexible intake pipe of the sampler was placed over the exhaust pipe of the vehicle. Placing the sampler intake pipe as shown in Figure 16 created a partial vacuum in the vehicle exhaust system. Using a U-tube manometer connected to a static pressure tap between the muffler and engine of the truck, it was found under idle and other closed throttle conditions that up to 4 in. H_2O less pressure than normal was induced by the action of the high entrainment of diluent. A design change of attaching a cone on the entrance of the stainless steel flexible pipe reduced the high entrance velocity and eliminated the partial vacuum in the exhaust system created by the system blower. An 18 in. long cone, increasing the inlet diameter from 6 to 12 in. (118 instead of 18.8 sq in.), was effective in reducing the inlet velocity from 7280 to 1210 ft/min during high speed operation. This cone, shown in Figure 17, appears to have no effect on engine-vehicle operation and is suggested for addition to the truck version of the PHS sampler.

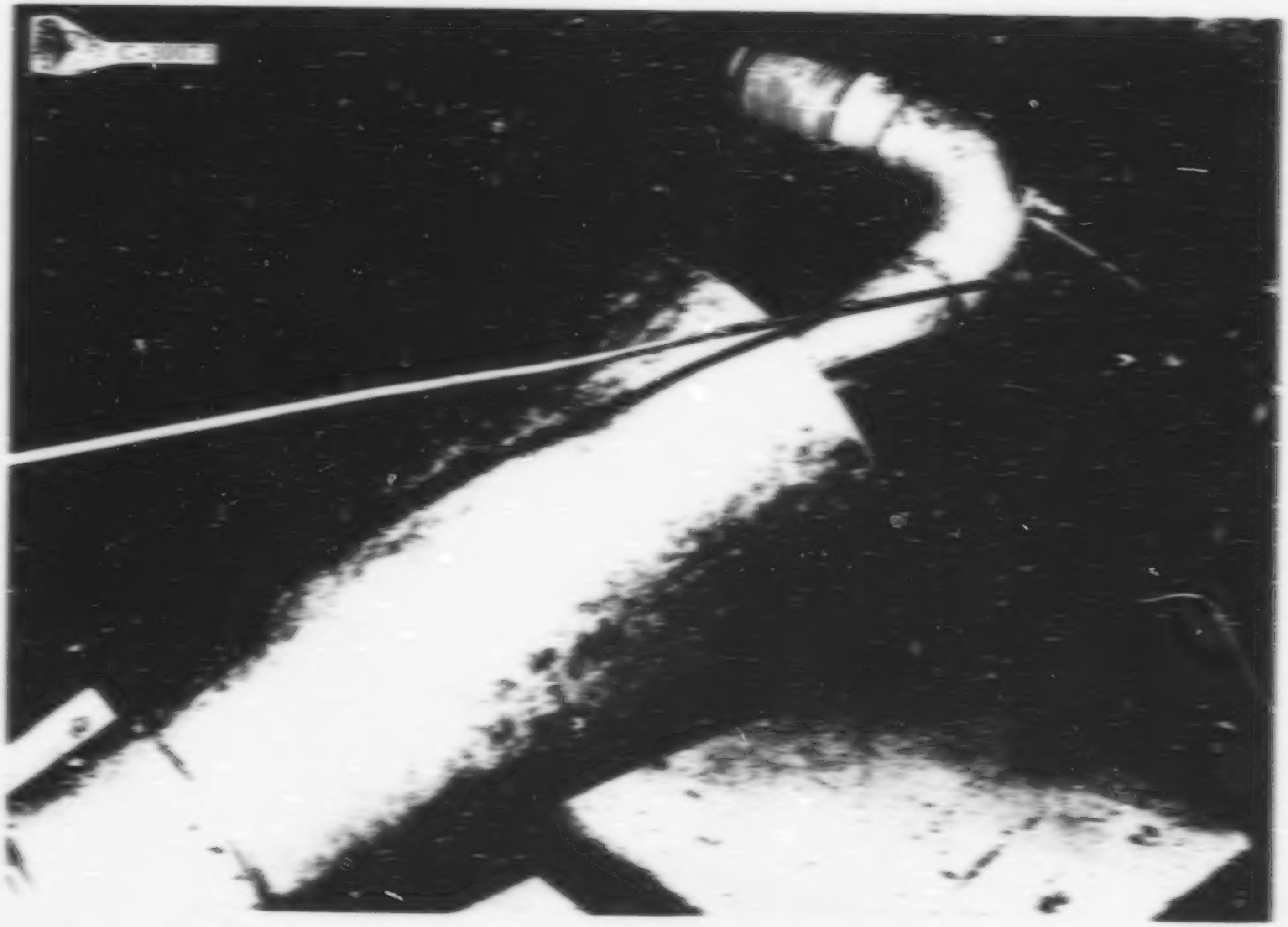


FIGURE 17. EXHAUST INLET CONE FOR USE WITH TRUCK VERSION PHS VARIABLE DILUTION SAMPLER

D Sampling, Analysis and Computation Procedure

A tentative sampling procedure developed for the two-speed truck version of the variable dilution sampling system is described in Table 2. Following this procedure stepwise will result in the Tedlar sample bag holding approximately 4 cu ft of diluted sample for every minute of operation. Once the sample procedure has been conducted, about 2 to 3 cu ft of the diluted and bagged exhaust is transferred to a small Tedlar transfer bag. This more manageable quantity of exhaust is then carried into the analytical laboratory for measurement of CO, CO_2, unburned hydrocarbons, oxides of nitrogen. The analysis cart incorporating suitably spanned, low range Beckman 315 nondispersive infrared analyzers for CO, CO_2, and unburned hydrocarbons is shown in Figure 18. Also shown is the Beckman 109 flame ionization detector instrument used to measure total unburned hydrocarbons as ppm C. Not shown is a Beckman polarograph instrument for oxygen determination. A modified Saltzman syringe technique was employed to measure total NO_x as ppm NO_2. The NO_x, prevalent in the engine exhaust at time of sampling and analysis, is purposely oxidized to its more stable state, NO_2, and the concentration read colorimetrically as ppm NO_2.

After the analysis of the transfer bag contents is complete and the meter readings recorded on the data sheet shown as Table 3, the computations of the mass emissions may be accomplished. Referring to Table 3, the following data reduction system, identical to that used with the automotive system and in accord with Reference 3, may be used to obtain the desired end result, namely mass emissions on a pound/mile or gram/mile basis:

(1) Record the distance traveled, and the overall average integrated temperature of the sample from the recorder. (Use the sample pump inlet temperature reading.)

(2) Record the total sampling time ("T") and the number of cycles sampled ("A").

(3) Go to calibration curve of standard cubic feet flowed versus sample temperature, Figures 12 or 15, and record the scfm flowed ("V").

(4) Convert revolutions of dynamometer rolls to miles per cycle ("D").

(5) Compute SCF/mile (VT/DA).

(6) Read concentrations of HC, CO, CO_2, NO_x, and O_2 and record.

TABLE 2. TENTATIVE OPERATING PROCEDURE FOR PHS VARIABLE DILUTION SAMPLING SYSTEM

General

To obtain a bag sample of vehicle exhaust for emissions analysis the high speed 4.873 in. ID inlet orifice and 0.402-in. ID isokinetic sample probe must be used with the high speed 1700-rpm system blower speed. The low speed, 3.146-in. ID inlet orifice and 0.49-in. ID isokinetic sample probe must be used with the low speed 1150-rpm system blower speed.

Procedure

(1) Set powerstat to give 220 volts and start cooling fan, "high" or "low" system blower and sample pump. Adjust powerstat to exactly 220 volts on voltmeter to give 1700 or 1150 rpm. Note: Do not change from high to low speed system blower without permitting speed to decrease to less than 1150 rpm.

(2) Turn "on" Cadillac suction fan to evacuate sampling bag. The three-way valve closed to sample pump and sample pump vented to atmosphere.

(3) After sample bag is evacuated, simultaneously close two-way aluminum valve and move three-way valve to permit sample to enter bag. This movement will start the electronic counter which has been zeroed. Normally, this step will coincide with the start of the chassis dynamometer cycle.

(4) At end of chassis dynamometer cycle, move three-way valve to permit sample to be vented. Do not move two-way aluminum valve.

(5) Record applicable items on variable dilution sampler data sheet.

(6) Using the Dynapump transfer system, transfer from large sample bag into transfer bag. Assist gas mixing in large bag by shaking. Permit the first 10 to 15 sec of transfer gas to be vented before "plugging in" the transfer bag.

(7) Always leave large bag evacuated or partially filled with laboratory air when unit is to be shut down.

(8) Turn off all instruments, blowers/motors and turn powerstat to "0" when system is to be shut down overnight.

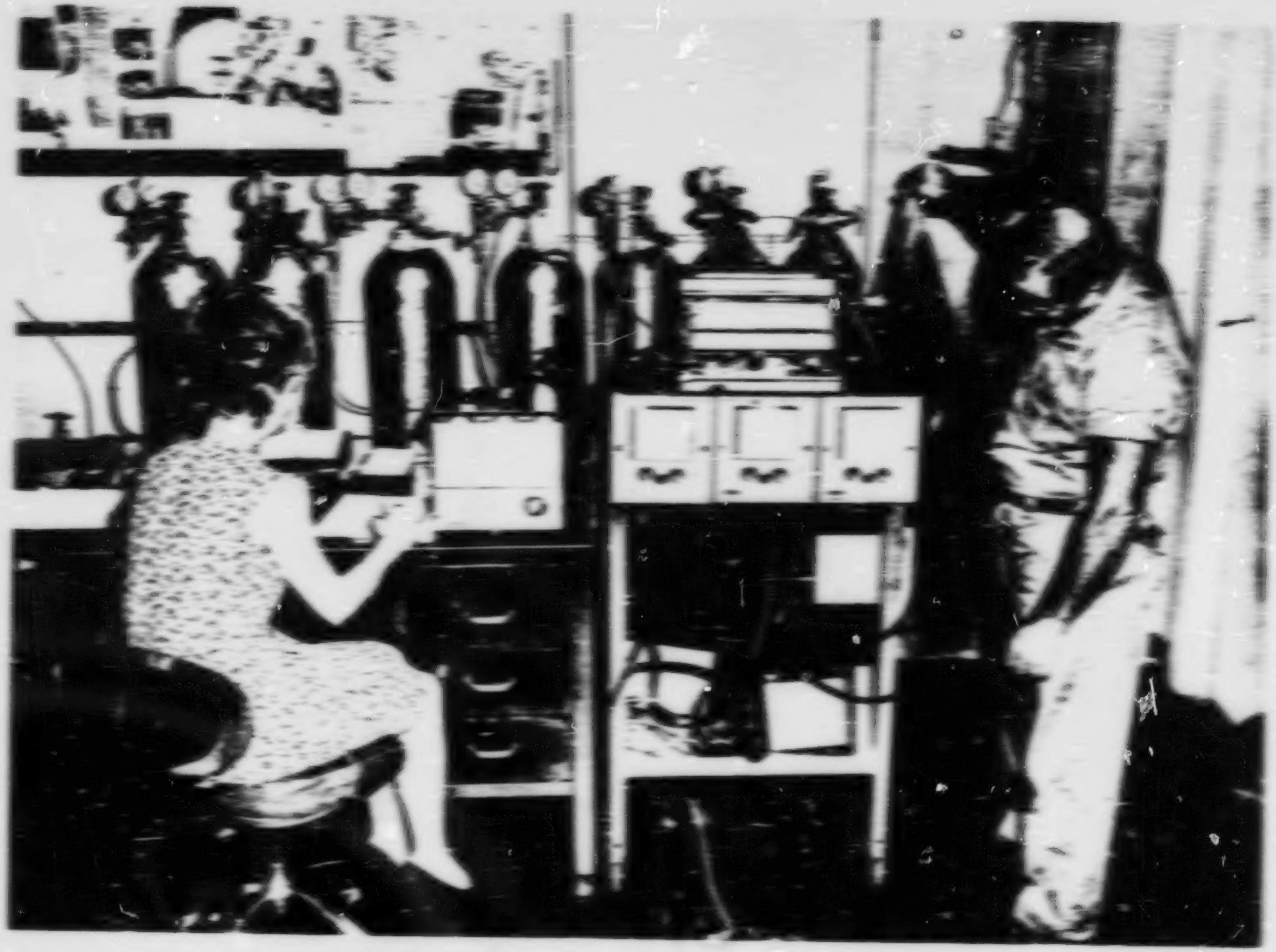


FIGURE 18. BAG SAMPLES OF VEHICLE EXHAUST ANALYZED BY FLAME IONIZATION AND NONDISPERSIVE INFRARED METHODS

TABLE 5. DATA SHEET FOR VARIABLE DILUTION SAMPLING SYSTEM

Bar __________ in Hg　　Wet __________ °F
Corr __________ in Hg　　Dry __________ °F
Date __________ Engine Make __________ Project __________
Run No. __________ Cyl/Disp _____/_____ Tire Size __________
Vehicle Year/Make _____/_____ Trans. No. _____ Odometer _____
Type Vehicle __________ Axle Ratio __________ No. of Axles __________
Cycle Description ______________________________
Time of Day __________ Blower Speed _____ High _____ Low
Total Distance Traveled __________ rev. of 8-5/8-in. OD dyno rolls

Integrated Overall Average Gas Temperature at Inlet to Sample Pump __________ °F

T: Total Sampling Time __________ min

A: Number of Cycles Sampled __________

Calculate:

V: Total SCFM from Applicable Calibration Curve __________ SCFM

D: Miles Traveled per Cycle, $\dfrac{\text{Dyno Rev.} \times 4.15 \times 10^{-4}}{\text{Number of Cycles Operated}}$

$$= \frac{(\quad) \times 4.15 \times 10^{-4}}{(\quad)} = \underline{\qquad} \frac{\text{miles}}{\text{cycle}}$$

Standard Cubic Feet per Mile:

$$\text{SCF/MILE} = \frac{VT}{DA} = \frac{(\qquad)(\qquad)}{(\qquad)(\qquad)} = \underline{\qquad\qquad} \text{SCF/MILE}$$

Meter Reading	Concentration		SCF/Mile	%/100	Lb Mol Wt / 385.2	Lb/Mile
	HC/Infrared	ppmc			0.03597	
	HC/FIA	ppmc			0.03597	
	CO	%			0.07269	
	CO_2	%			0.11422	
	NO_x	ppm			0.11940	
	O_2	%				

NO_x Syringe No. 1 __________ No. 2 __________ Bag No. __________

(7) Convert concentration reading to common basis as %/100.

(8) Multiply (SCF/mile) × (%/100) × (lb mol wt) conversion factor to obtain lb/mile and record. Conversion factor is listed in the Appendix per Reference 3.

The above sampling, analysis, and computational procedures, associated with the variable dilution sampling system, are the simplest to use of all known bag or continuous systems. This method is easy and quick to use and appears highly reliable based on data obtained to date. The run-to-run repeatability obtained and inherent via this system seems to justify the system concept and design.

E. Limited Typical Results

To complete this discussion of the truck size variable dilution sampler, limited, preliminary results are presented in Table 4. For comparison purposes, simultaneous variable dilution and proportional samples were obtained. The Pace proportional sampling system procures an exhaust sample proportional to the airflow rate through the carburetor. The emissions data for Table 4 were obtained using an experimental twelve-mode cyclic test procedure at level road load and uphill road load for the Class IV 1966 International Harvester V-8 truck. A ten-mode cycle at level road load experimental test procedure was employed with a Class III, 1965 Chevrolet, six-cylinder truck. Comparing the average values (minimum of four runs involved for each sampler comparison series) indicates that unburned hydrocarbons by both methods are always greater for the variable dilution sampler regardless of vehicle or cycle load. NO_x values were also higher for the Class IV experiments at level road load, about the same for the Class IV uphill road load condition, and less for the Class III runs. CO, on a pound/mile basis, showed excellent agreement throughout this series of runs, regardless of vehicle dynamometer cycle. CO_2, like unburned hydrocarbons, was always greater for the variable dilution method.

To gain a better understanding of the system's temperature characteristic, various temperatures were recorded during a typical experimental ten-mode Class III chassis dynamometer cycle at level road load. This cycle was run four consecutive times in a total time of 7 min. Figures 19 and 20 show the heat exchanger inlet and outlet diluted exhaust temperatures during the four cycles and indicate the effectiveness of this item as a "heat sink." The dilute exhaust temperatures at the inlet and outlet of the sample pump are shown in Figures 21 and 22. The effect of the sample pump is to smooth out the sample temperature without a noticeable addition of heat by the pump.

TABLE 4. COMPARISON OF PACE PROPORTIONAL SAMPLER WITH VARIABLE DILUTION SAMPLER EMISSION RESULTS

Vehicle	Cycle	Sampler		NDIR UBHC, lb/mi	FIA UBHC, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi
Class IV 1966 IHC 345 V-8	*	Pace Proport.	Max	0.0244	0.0498	0.0131	0.412	1.890
			Min	0.0229	0.0482	0.0125	0.426	1.812
			Avg	0.0236	0.0489	0.0127	0.421	1.844
		Variable Dilution	Max	0.0252	0.0541	0.0201	0.456	2.095
			Min	0.0245	0.0479	0.0161	0.406	1.890
			Avg	0.0248	0.0517	0.0172	0.438	1.980
Class IV 1966 IHC 345 V-8	†	Pace Proport.	Max	0.0250	0.0552	0.0216	0.418	2.57
			Min	0.0197	0.0434	0.0161	0.367	2.07
			Avg	0.0214	0.0478	0.0184	0.393	2.295
		Variable Dilution	Max	0.0247	0.0542	0.0208	0.427	2.575
			Min	0.0240	0.0520	0.0161	0.372	2.370
			Avg	0.0242	0.0532	0.0188	0.397	2.49
Class III 1965 Chev 292 cu in.	‡	Pace Proport.	Max	0.0270	0.0505	0.0286	0.498	2.075
			Min	0.0241	0.0434	0.0218	0.428	1.90
			Avg	0.026	0.0482	0.0238	0.457	1.96
		Variable Dilution	Max	0.0310	0.0657	0.0232	0.496	2.197
			Min	0.0260	0.0635	0.0176	0.439	2.055
			Avg	0.0288	0.0648	0.0205	0.466	2.121

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*PHS twelve-mode Experimental Class IV Cycle at Level Road Load.

†PHS twelve-mode Experimental Class IV Cycle at Moderate Uphill Road Load.

‡PHS ten-mode Experimental Class III Cycle at Level Road Load.

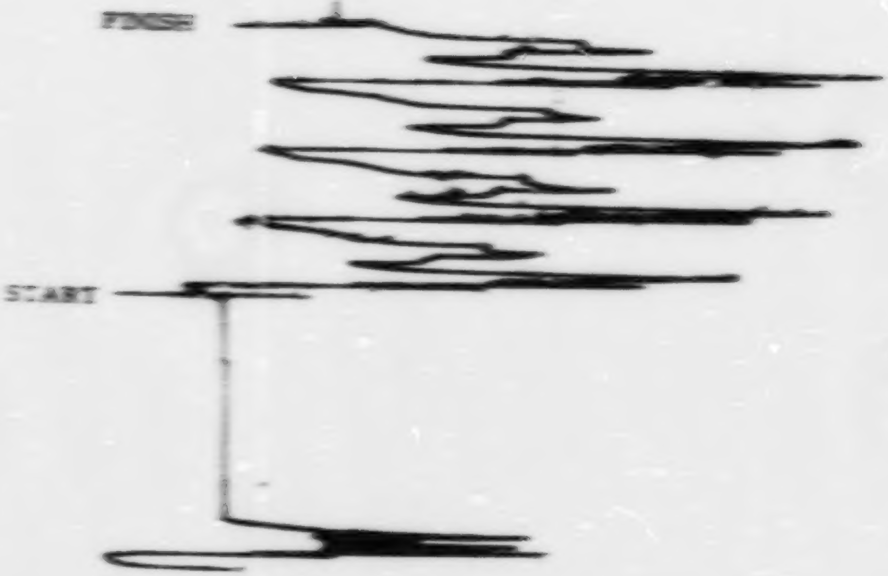

Chart Speed:
15 in/hr

FIGURE 19. GAS TEMPERATURE AT INLET TO HEAT EXCHANGER
1965 Chevrolet Van - 292 - Six Cylinder - January 9, 1968

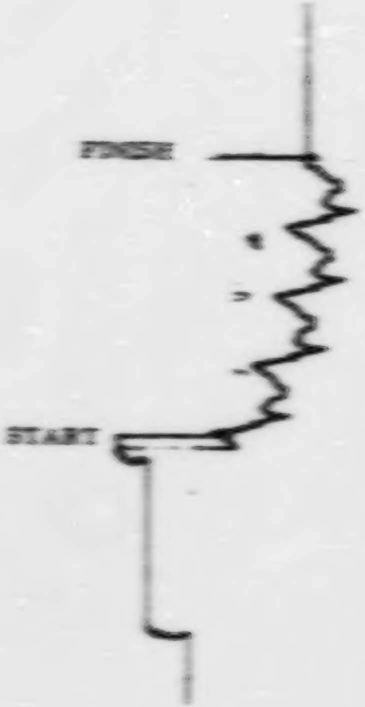

Chart Speed:
15 in/hr

FIGURE 20. TEMPERATURE OF GAS AT EXIT FROM HEAT EXCHANGER AND AT INLET TO SYSTEM BLOWER

1965 Chevrolet Van - 292 - Six Cylinder - January 9, 1968

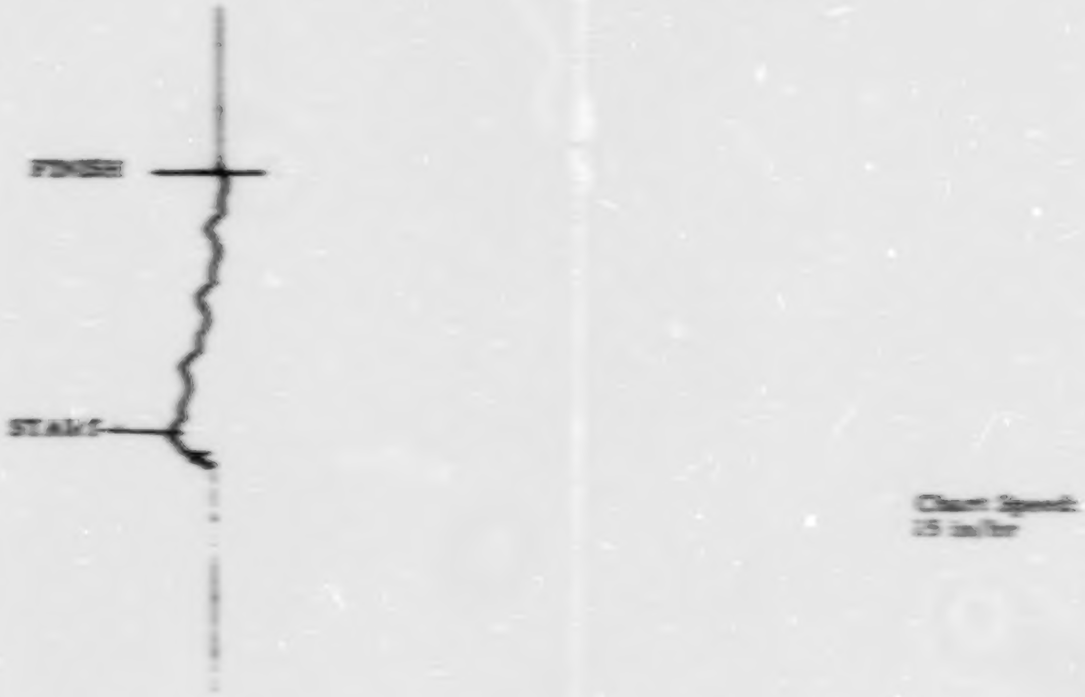

FIGURE 21. TEMPERATURE OF GAS AT INLET TO SAMPLE PUMP
1965 Chevrolet Van - 292 - Six Cylinder - January 5, 1968

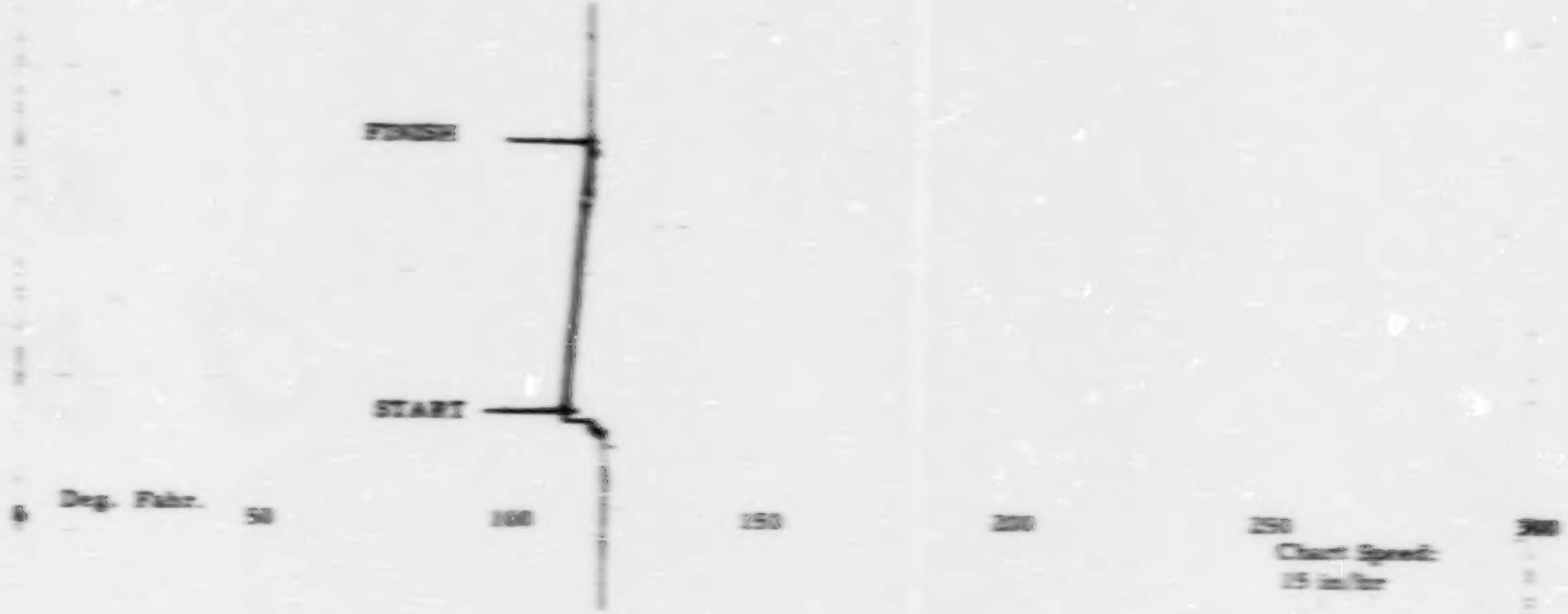

FIGURE 22. TEMPERATURE OF GAS AT EXIT OF SAMPLE PUMP
1965 Chevrolet Van - 292 - Six Cylinder - January 9, 1968

III. SUMMARY

Using the automotive prototype variable dilution sampler as a guide, a new version of this sampling system for use with trucks above 10,000-lb GVW has been prepared. The major change with the truck version was the capability of handling a threefold increase in exhaust and diluent airflow. This change necessitated a larger system blower and motor, as well as changes to the stainless steel air-to-air heat exchanger. The heat exchanger changes involved larger size tubes through which the exhaust and diluent air pass, as well as a substantially increased cooling air fan. In preparing the truck version, other design features were incorporated to improve and broaden the capability of the system. One major feature was the use of a two-speed motor to drive the system blower, and thereby provide approximately twice the air handling capability of the automotive prototype for use with trucks of the medium size category. Control features to maintain stable, repeatable, sampling system operation included a powerstat for control of motor and rotary pump speed, continuous temperature record, and provision for measuring system blower and sample pump speed, and sample pump revolutions.

A successful calibration of the two-speed truck version variable dilution sampler was accomplished and suitable operating procedures, analysis, and computation techniques prepared. During the calibration step, it became evident that an additional item, an inlet cone, was necessary to reduce the exhaust and diluent air velocity at the inlet to the 6-in. flexible exhaust pipe. This additional component was capable of handling the total exhaust of the vehicle, plus the diluent air without noticeably affecting the operation of the vehicle engine or its emissions at both system design speeds. A limited comparison of the truck version of the variable dilution sampler with the proportional sampling system (Pccs sampler) was also conducted. These limited results, obtained with a Class III and Class IV gasoline powered truck operated under a level road load and uphill road load cyclic test procedure, indicated higher overall mass emissions on a pound/mile basis with the variable dilution system versus the proportional system. Repeatability and reliability of the variable dilution system have been found to be noticeably better than with other vehicle exhaust sampling procedures and systems available.

REFERENCES

1. Louis C. Broering, Jr.; William J. Werner; Andrew H. Rose, Jr., "Automotive Mass Emission Analysis by a Variable Dilution Technique," Presented at the APCA Annual Meeting, June 1967.

2. ASME, Flowmeter Computation Handbook, Prepared by the ASME Research Committee on Fluid Meters, The American Society of Mechanical Engineers, 1961.

3. Correspondence, Ralph Stahman, NCAPC, Cincinnati, Ohio, to Karl Springer, SwRI, dated November 24, 1967.

APPENDIX

CONVERSION FACTOR TO GET LB/MILE BASIS

$$(22.41 \text{ L/gram-mole})(\text{ft}^3/28.32 \text{ L})(453.6 \text{ gram-mole/lb mole})(528/492) =$$

$$\frac{(22.41)(453.6)(528)}{(28.32)(492)} = 385.2 \quad \text{SCF}(68°\text{F})/\text{lb mole}$$

TO GET LB MASS/MILE FROM CONCENTRATION

$$[\text{Total SCF }(68°\text{F})/\text{mile flowed}](\% \times 10^{-2} \text{ concentration})$$

$$\left(\frac{\text{mol wt (lb mass/lb mole)}}{385.2 \text{ SCF }(68°\text{F})/\text{lb mole}}\right) = \text{lb/mile}$$

Note: The above per correspondence from Mr. Ralph Stahman, NCAPC, Cincinnati, to Karl Springer, SwRI, dated November 24, 1967.

APPENDIX B

OPERATING REVISIONS TO ETHYL GENERALIZED CYCLE FIELD AND DYNAMOMETER DATA

TABLE B-1. SwRI ROAD LOAD AND CHASSIS DYNAMOMETER OPERATING CHARACTERISTICS OF 1968 CHEVROLET STAKE CLASS II VEHICLE

Vehicle: 1968 Chevrolet Stake	**Transmission:** 4-Speed
Engine: 250 cu in., 6 cylinder	**Axle:** 1 Speed
GVW: 10,000 lb	**Tire Size:** 7.50 × 20
Date: July 28, 1968	**Inertia:** 8,000 lb

Road Load Initial Conditions: Vehicle with tare weight of 4300-lb was loaded with approximately 0.5 of payload weight to result in 7,150-lb half-loaded vehicle. Barometric pressure was 29.02 in. Hg adjusted to sea level, 78/80°F wet/dry bulb temperature. Data obtained on level road both north and south and averaged. Ambient temperature was 80°F. Calm wind.

Operating Data		Road Data				Dynamometer Data		
				Temperatures, °F				
Vehicle Speed, mph	Transmission Gear No.	Intake Vacuum, in. Hg	Engine Speed, rpm	Air Cleaner Inlet	In Front of Grill	Intake Vacuum, in. Hg	Vehicle Output, hp	Engine Speed, rpm
5	1	21.2	2025	89	80	20.2	0.5	1850
10	2	21.0	2075	86	78	20.0	1.0	2000
15	2	20.7	3000	87	78	19.5	1.4	3000
20	3	19.2	1950	85	77	18.0	2.1	1875
25	3	18.5	2400	87	78	18.2	2.6	2300
30	3	16.6	2750	83	77	16.4	4.2	2750
30	4	16.0	1625	84	79	16.0	5.0	1600
35	4	15.5	1925	85	79	15.8	6.1	1900
40	4	14.1	2250	83	78	15.1	8.0	2175
45	4	13.2	2425	85	80	14.4	12.0	2425
50	4	11.8	2725	86	78	13.2	15.5	2700
55	4	10.0	3000	84	77	12.1	20.5	3000

TABLE B-2. DYNAMOMETER CYCLE FOR CLASS II TRUCKS
(Generalized Cycle Proposed by Ethyl)

Repeat for a Total of Four Cycles

Mode	Man. Vac. in. Hg	Rear-Wheels' Speed, mph	Engine, rpm	Duration, sec
1. Idle	(a)	0	(b)	22
2. Gear-1*	6	(c)	Idle-2200	(d)
3. Gear-2*	WOT	(c)	To 2200	(d)
4. Gear-3*	6	To 32	(c)	(d)
5. Decel	CT	32–27	(c)	(e)
6. Accel	WOT	27–32	(c)	(d)
7. Decel	CT	32–20	(c)	(g)
8. Accel	6	20–29	(c)	(g)
9. Cruise	(f)	29	(c)	22
10. Decel	CT	29–19	(c)	(g)
11. Accel	6	19–29	(c)	(g)
12. Decel	CT	29–0	To Idle†	(g)

(a) Not specified - idle mixture adjusted to give highest smooth idle rpm.
(b) Manufacturer's specifications.
(c) Not specified - function of tire size and gear ratios.
(d) Not specified - varies with inertia load applied to equal road accel at 50 percent load.
(e) Not specified - normal decel against applied inertia load.
(f) Not specified - cruise load set to absorb 13.9 hp at rear wheels.
(g) Not specified - function of inertia and cruise loads at cruise load condition.

---

*Use gears 2, 3, 4 if four speed transmission. On transmission with overdrive, overdrive is locked out.
†Declutch at 10-12 mph and start timer for next idle mode.

TABLE B-3. CHASSIS DYNAMOMETER CYCLE FOR CLASS II MEDIAN TRUCK*
(Ethyl Results of Median Truck on Generalized Cycle)

Repeat for a Total of Four Cycles

Vehicle: 1964 GMC 1502 Pickup
Engine: 305 CID, V-6

GVW: 7500 lb
N/V: 46.5

Mode	Man. Vac, in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec
1. Idle	(a)	0	(b)	22
2. Gear-1		0-16	Idle-2300	6
3. Gear-2	WOT	15-27	1750-3200	5
4. Gear-3	6	26-32	1250-1550	8
5. Decel	CT	32-27	1550-1300	6
6. Accel	WOT	27-32	1300-1550	5
7. Decel	CT	32-20	1550-950	5
8. Accel	6	20-29	950-1400	6
9. Cruise	10†	29	1400	22
10. Decel	CT	29-19	1400-900	9
11. Accel	8	19-29	900-1400	5
12. Decel	CT	29-0	1400-Idle‡	15

(a) Not specified - idle mixture adjusted to give highest smooth idle rpm.
(b) Manufacturer's specifications.

---

*One truck in each weight group was selected on the basis of physical characteristics as being most representative of that group.
†Corresponds to 13.9 rear wheel hp.
‡Declutch at 10-12 mph and start timer for next idle mode.

TABLE B-4. SwRI RESULTS WITH PROPOSED ETHYL CLASS II CYCLE

Repeat for a Total of Four Cycles

Vehicle: 1968 Chevrolet Stake
Engine: 250 CID, L6

GVW: 10,000 lb
N/V: 53.4

Mode	Man. Vac, in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec	Cumulative Time, Min:Sec
1. Idle	21	0	600	22	0:22
2. Gear-1	8	0-16	[illegible]	6	0:28
3. Gear-2	WOT	15-27	1400-2300	6	0:34
4. Gear-3	8	26-32	1450-1650	8	0:42
5. Decel	CT	32-27	1650-1500	6	0:48
6. Accel	WOT	27-32	1400-1650	3	0:51
7. Decel	CT	32-20	1650-1050	10	1:01
8. Accel	8	20-29	1050-1450	12	1:13
9. Cruise	10*	29	1450	22	1:35
10. Decel	CT	29-19	1450-950	9	1:44
11. Accel	8	19-29	950-1450	16	2:00
12. Decel	CT	29-0	1450-500†	15	2:15

---

*Corresponds to 5 rear-wheel hp.
†Declutch at 10-12 mph and start timer for next idle mode.

TABLE 6-5. SwRI RESULTS WITH CLASS II EXPERIMENTAL CHASSIS DYNAMOMETER CYCLE*

Repeat for a Total of Four Cycles

Vehicle: 1968 Chevrolet Stake
Engine: 250 CID, I-6

GVW: 10,000 lb
N/V: 53.4

Dynamometer Initial Conditions: At 30 mph in fourth gear, conditions were 5 rear-wheel hp, 16 in. Hg intake manifold vacuum at 1600-rpm engine speed.

Mode	Man. Vac, in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec	Cumulative Time, Min:Sec
1. Idle	21	0	500	22	0:22†
2. Gear-2	WOT	0–16	500–2700	4	0:26
3. Gear-3	WOT	15–27	1700–2300	6	0:32
4. Gear-4	WOT	26–32	1500–1650	5	0:37
5. Decel (With brakes if necessary)	CT	32–27	1650–1400	6 (Do not exceed)	0:43
6. Accel	WOT	27–32	1400–1650	3	0:46
7. Decel (With brakes if necessary)	CT	32–20	1650–1050	9†	0:55
8. Accel	6	20–30	1050–1600	12	1:07
9. Cruise	16	30	1600	22	1:29†
10. Decel (With brakes if necessary)	CT	30–20	1600–1050	9†	1:38
11. Accel	WOT	20–30	1050–1600	8	1:46
12. Decel	CT‡	30–0	1600–0	14	2:00†

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*As specified by R. Olson and R. Springer per August 30, 1968, discussion.
†Time specified must be met.
‡Declutch at 2:00 min and allow engine to idle (start time for next cycle, mode 1 - use brakes to slow to stop).

TABLE B-6. COMPARISON OF TWO DIFFERENT PERFORMING VEHICLES WITH CLASS II EXPERIMENTAL CHASSIS DYNAMOMETER CYCLE*

Repeat for a Total of Four Cycles

			Vehicle: 1968 Chevrolet Stake Engine: 250 CID, I-6 GVW: 10,000 lb		Vehicle: 1963 Ford Stake Engine: 223 CID, I-6 GVW: 10,000 lb	
Mode	Man. Vac., in. Hg	Rear Wheels' Speed, mph	Duration, sec	Cumulative Time	Duration, sec	Cumulative Time, Min:Sec
1. Idle		-	22	22†	22	0:22†
2. Gear-2	WOT	0 - 16	4	26	6	0:28
3. Gear-3	WOT	15 - 27	6	32	8	0:36
4. Gear-4	WOT	26 - 32	5	37	8	0:44
5. Decel (With brakes if necessary)	CT	32 - 27	6 (Do not exceed)	43	6	0:50
6. Accel	WOT	27 - 32	3	46	6	0:56
7. Decel (With brakes if necessary)	CT	32 - 20	9†	55	9†	1:05
8. Accel	6	20 - 30	12	1:07	14	1:19
9. Cruise	Road Load‡	30	22	1:29†	10	1:29†
10. Decel (With brakes if necessary)	CT	30 - 20	9†	1:38†	9†	1:38†
11. Accel	WOT	20 - 30	8	1:46	14	1:52
12. Decel	CT**	30 - 0	14	2:00†	8	2:00†

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[*] As specified by R. Olsen and [illegible] per August 30, 1968, discussion.
[†] Time specified must be met.
[‡] For 250 CID Chevrolet, 10,000 lb GVW stake corresponds to 5 hp at 30 mph, 15 in. Hg.
[**] Declutch at 2:00 min and allow engine to idle (start time for next cycle, mode 1 - use brakes to slow to stop).

TABLE B-7. SwRI ROAD LOAD AND CHASSIS DYNAMOMETER OPERATING CHARACTERISTICS OF 1965 CHEVROLET C-60 VAN TRUCK CLASS III VEHICLE

Vehicle: 1965 Chev. C-60 van
Engine: Chev. 292, 6 cylinder
GVW: 19,500 lb
Date: August 7, 1967

Transmission: 4 speed
Axle: 1 speed, 7.40:1
Tire Size: 8.25-20
Inertia: 16,000 lb

Road Load Initial Conditions: Vehicle with tare weight of 8310 lb was loaded with approximately 0.5 of payload weight to result in 14,040-lb half-loaded vehicle. Barometric pressure was 29.16 in. Hg adjusted to sea level, 82°/85°F wet/dry temperature; data obtained on level road both north and south and averaged. Ambient temperature was 95°F. Calm wind.

Operating Data		Road Data				Dynamometer Data		
				Temperature, °F				
Vehicle Speed, mph	Transmission Gear No.	Intake Vacuum, in. Hg	Engine Speed, rpm	Air Cleaner Inlet	In Front of Grill	Intake Vacuum, in. Hg	Vehicle Output, hp	Engine Speed, rpm
10	2	18.5	2400	117	97	19.5	5	2300
15	2	17.5	3600	122	97	19	6	3400
20	3	17.5	2300	120	96	19	8	2200
25	3	17	2850	119	96	18	12	2800
30	4	15	2150	112	96	15	18	1950
35	4	14.5	2400	107	95	14	26	2300
40	4	12.5	2600	103	96	12	36	2550
45	4	12.5	3050	103	94	11	40	2900
50	4	11	3300	104	95	9	63	3250
55	4	9	3550	103	95	6	82	3550

TABLE B-8. DYNAMOMETER CYCLE FOR CLASS III TRUCKS WITH FOUR-SPEED TRANSMISSION (Generalized Cycle Proposed by Ethyl)

Repeat for a Total of Four Cycles

Mode	Man. Vac., in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec
1. Idle	(a)	0	(b)	20
2. Gear 2	WOT	(c)	Idle-2100	(d)
3. Gear 3	WOT-7*	(c)	To 2100	(d)
4. Gear 4	WOT	To 35	(c)	(d)
5. Decel	CT	35-25	(c)	(e)
6. Cruise	(f)	25	(c)	15
7. Accel	7	25-28	(c)	(e)
8. Cruise	(f)	28	(c)	15
9. Decel	CT	28-0	To Idle†	(e)

(a) Not specified - idle mixture adjusted to give highest smooth-idle rpm.
(b) Manufacturer's specifications.
(c) Not specified - function of tire size and gear ratios.
(d) Not specified - varies with inertia load applied to equal road accel at 50 percent load.
(e) Not specified - function of inertia and cruise loads at cruise load condition.
(f) Not specified - cruise load set to absorb 22.2 hp at rear wheels at 25 mph, and 28.0 hp at 28 mph.

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*First half of accel at WOT; second half at 7 in. Hg.
†Declutch at 10-12 mph and start timer for next idle mode.

TABLE B-9. CHASSIS DYNAMOMETER CYCLE FOR CLASS III MEDIAN TRUCK*
(Ethyl Results of Median Truck on Generalized Cycle)

Repeat for a Total of Four Cycles

Vehicle: 1967 Ford Stake
Engine: 330 CID, V-8

GVW: 20,000 lb
N/V: 56.7

Mode	Man. Vac. in. Hg	Rear Wheels' Spe'd, mph	Engine, rpm	Duration, sec
1. Idle	(a)	0	(b)	20
2. Gear-2	WOT	0-13	Idle-2400	3
3. Gear-3	WOT-7*	9-21	1100-2600	10
4. Gear-4	WOT	20-26	1400-2000	6
5. Gear-5	WOT	24-35	1400-2100	12
6. Decel	CT	35-25	2100-1400	10
7. Cruise	12.5†	25	1400	12
8. Accel	7	25-28	1400-1600	6
9. Cruise	11.5‡	28	1600	12
10. Decel	CT	0	1600-Idle**	15

(a) Not specified - idle mixture adjusted to give highest smooth idle rpm.
(b) Manufacturer's specifications.

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*Full throttle to 1900 rpm, 7 in. Hg from 1900 to 2600 rpm.
†Corresponds to 22.2 rear-wheel hp.
‡Corresponds to 18.8 rear-wheel hp.
**Declutch at 10-12 mph and start timer for next idle mode.

TABLE B-10. SwRI RESULTS WITH PROPOSED ETHYL CLASS III CYCLE

Repeat for a Total of Four Cycles

Vehicle: 1965 Chevrolet C-60 Van
Engine: 292 CID, L-6

GVW: 19,500 lb
N/V: 64.3

Mode	Man. Vac. in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec	Cumulative Time, Min:Sec
1. Idle	18	0	450	20	0:20
2. Gear-2	WOT	0-9	450-1900	4	0:24
3. Gear-3	WOT	9-18	1150-2900	6	0:30
4. Gear-4	WOT	18-35	1300-2300	17	0:47
5. Decel	CT	35-25	2300-1600	14	1:01
6. Cruise	16*	25	1600	12	1:13
7. Accel	PT	25-28	1650-1800	6	1:19
8. Cruise	13.5	28	1800	12	1:31
9. Decel	CT	28-0	1800-450	15	1:46

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*Corresponds to 12 rear-wheel hp.
†Declutch and start timer for next idle mode.

TABLE B-11. SwRI RESULTS WITH CLASS III EXPERIMENTAL CHASSIS DYNAMOMETER CYCLE*

Repeat for Total of Four Cycles

Vehicle: 1965 Chevrolet C-60 Van
Engine: 292 CID, I-6

GVW: 19,500 lb
N/V: 64.3

Dynamometer Initial Conditions: At 30 mph in fourth gear, conditions were 18 rear-wheel hp, 15 in. Hg intake manifold vacuum at 1950-rpm engine speed.

Mode	Man. Vac, in. Hg	Rear-Wheels' Speed, mph	Engine, rpm	Duration, sec	Cumulative Time, Min:Sec
1. Idle	18	0	450	20†	0:20†
2. Gear-2	WOT	0 - 12	450 - 2400	5	0:25
3. Gear-3	WOT	12 - 24	1400 - 2600	7	0:32
4. Gear-4	WOT	24 - 35	1600 - 2200	12.5	44.5
5. Decel (With brakes)	CT	35 - 25	2200 - 1600	12.5	0:57
6. Cruise	16	25	1600	15	1:12†
7. Accel	PT	25 - 28	1600 - 1800	6†	1:18†
8. Cruise	15.5	28	1800	12†	1:30†
9. Decel	CT‡	28 - 0	1800 - 450	16†	1:46†

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*As specified by B. Olsen and K. Springer per August 17, 1967, discussion.
†Time specified must be met.
‡Declutch at 2:00 min and allow engine to idle (start time for next cycle, mode 1 - use brakes to slow to stop).

TABLE B-12. SwRI ROAD LOAD AND CHASSIS DYNAMOMETER OPERATING CHARACTERISTICS OF 1966 IHC LS1700 STAKE TRUCK CLASS IV VEHICLE

Vehicle: 1966 IHC LS1700 Stake
Engine IHC 345, V-8
GVW: 24,000 lb
Date: August 8, 1967

Transmission: 5 speed
Axle: 1 speed, 6.50:1
Tire Size: 9.00-20
Inertia: 16,000 lb

Road Load Initial Conditions: Vehicle with tare weight of 9030 lb was loaded with approximately 0.5 of payload weight to result in 16,530-lb half-loaded vehicle. Barometric pressure was 29.25 in. Hg adjusted to sea level, 78°/82°F wet/dry bulb temperature. Data obtained on level road both north and south and averaged. Ambient temperature was 90°F. Calm wind.

Operating Data		Road Data				Dynamometer Data		
				Temperatures, °F				
Vehicle Speed, mph	Transmission Gear No.	Intake Vacuum, in. Hg	Engine Speed, rpm	Air Cleaner Inlet	In Front of Grill	Intake Vacuum, in. Hg	Vehicle Output, hp	Engine Speed, rpm
10	3	18	2250	12?	92	19	2	2200
15	3	19	1950	120	91	19	3	1950
20	3	17.5	2500	121	91	18	6	2600
25	4	16.5	1900	120	91	17	10	2000
30	4	16	2250	11?	91	16	13	2350
35	5	15	1950	119	90	14	20	1950
40	5	13	2150	118	90	12.5	26	2200
45	5	10	2300	117	90	11	34	2500
50	5	9	2600	116	90	8	44	2700
55	5	6	2800	117	92	1.5	56	3000

TABLE B-13. SwRI ROAD LOAD AND CHASSIS DYNAMOMETER OPERATING CHARACTERISTICS OF 1967 CHEVROLET C60 STAKE TRUCK CLASS IV VEHICLE

Vehicle: 1967 Chevrolet C-60 Stake
Engine: Chevrolet 366, V-8
GVW: 30,000 lb
Date: December 20, 1967

Transmission: 5 speed Clark Model 285 VI
Axle: DI-290 with Eaton 2 speed–3241
Tire Size: 9.00-20
Inertia: 16,000 lb

Road Load Initial Conditions: Vehicle with tare weight of 8,000-lb was loaded with approximately 0.5 of payload weight to result in 19,000-lb half-loaded vehicle. Barometric pressure was 29.35 in. Hg adjusted to sea level, 44°/48°F wet/dry bulb temperature. Data obtained on level road both north and south and averaged. Ambient temperature was 46°F. Calm wind. Vehicle operated in high range of Eaton 2 speed (button out).

Operating Data		Road Data				Dynamometer Data		
				Temperatures, °F				
Vehicle Speed, mph	Transmission Gear No.	Intake Vacuum, in. Hg	Engine Speed, rpm	Air Cleaner Inlet	In Front of Grill	Intake Vacuum, in. Hg	Vehicle Output, hp	Engine Speed, rpm
10	2	19.3	2500	67	42	19.8	5	2475
15	3	19.0	2050	66	44	19.1	5	2025
20	3	18.0	2750	64	45	18.0	6	2700
25	3	16.3	3450	63	43	16.5	8	3350
25	4	17.5	2250	63	43	17.9	8	2200
30	4	15.9	2700	67	44	16.0	12	2650
35	4	14.9	3150	66	44	14.5	18	3100
35	5	15.0	2200	64	45	14.9	18	2100
40	5	13.8	2450	67	45	13.2	24	2400
45	5	11.6	2750	72	44	10.5	32	2700
50	5	10.1	3075	65	43	8.5	42	3000
55	5	7.8	3350	68	40	5.8	58	3250

TABLE B-14. DYNAMOMETER CYCLE FOR CLASS IV TRUCKS
(Generalized Cycle Proposed by Ethyl)

Repeat for a Total of Two Cycles

Mode	Man. Vac, in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec
1. Idle	(a)	0	(b)	27
2. Gear 2	6	(c)	Idle–3000	(d)
3. Gear 3	WOT-6*	(c)	To 3000	(d)
4. Gear 4	WOT	(c)	To 2900†	(d)
5. Gear 5	6	To 35	(c)	(d)
6. Decel	CT	35–21	(c)	(e)
7. Cruise	(f)	21	(c)	28
8. Accel	(g)	21–34	(c)	(e)
9. Cruise	(f)	34	(c)	28
10. Decel	16	34–21	(c)	(e)
11. Cruise	(f)	21	(c)	37
12. Decel	CT	21–0	To Idle‡	(e)

(a) Not specified–idle mixture adjusted to give highest smooth-idle rpm.
(b) Manufacturer's specifications.
(c) Not specified–function of tire size and gear ratios.
(d) Not specified–varies with inertia load applied to equal road accel at 50 percent load.
(e) Not specified–function of inertia and cruise loads at cruise load condition.
(f) Not specified–cruise load set to absorb 25.3 hp at rear wheels at 21 mph, and 32.9 hp at 34 mph.
(g) Accel at 11 in. Hg manifold vacuum or 1 in. Hg below 34-mph cruise vacuum, whichever is lower.

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*First half of accel at WOT; second half at 6 in. Hg.
†Shift at 2900 rpm or 35 mph, whichever is lower.
‡Declutch at 10-15 mph and start timer for next idle mode.

TABLE B-15. CHASSIS DYNAMOMETER CYCLE FOR CLASS IV MEDIAN TRUCK

(Ethyl Results of Median Truck on Generalized Cycle)

Repeat for a Total of Two Cycles

Vehicle: 1966 Chevrolet Stake
Engine: 366 CID, V-8

GVW: 30,000 lb
N/V: 52.7

Mode	Man. Vac. in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec
1. Idle	(a)	0	(b)	27
2. Gear-2	8	0–12	Idle-3000	9
3. Gear-3	WOT-6*	10–21	1400–3000	9
4. Gear-4	WOT	18–32	1700–2800	9
5. Gear-5	8	28–35	1750–2200	9
6. Decel	CT	35–21	2200–1300	12
7. Cruise	13†	21	1300	13
8. Accel	11	21–24	1300–1500	20
9. Cruise	12‡	24	1500	19
10. Decel	18	24–21	1500–1300	28
11. Cruise	13†	21	1300	6
12. Decel	CT	21–0	1300–Idle**	28
				12

(a) Not specified - idle mixture adjusted to give highest smooth-idle rpm.
(b) Manufacturer's specifications.

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*Full throttle to 2200 rpm, 6 in. Hg from 2200 to 3000 rpm
†Corresponds to 25.2 rear-wheel hp.
‡Corresponds to 32.9 rear-wheel hp.
**Declutch at 10-12 mph and start timer for next idle mode.

TABLE B-16. SwRI RESULTS WITH PROPOSED ETHYL CLASS IV CYCLE

Repeat for a Total of Two Cycles

Vehicle: 1966 IHC LS 1700 Stake
Engine: 345 CID, V-8

GVW: 24,000 lb
N/V: 38.2

Mode	Man. Vac. in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec	Cumulative Time, Min:Sec
1. Idle	18	0	500	27	0:27
2. Gear-2	PT	0–11	500–2400	9	0:36
3. Gear-3	PT	11–20	1600–2550	9	0:45
4. Gear-4	WOT	20–31	1650–2300	9	0:54
5. Gear-5	WOT	31–35	1520–1900	13	1:07
6. Decel	CT	35–21	1900–1100	25	1:32
7. Cruise	16	21	1100	15	1:47
8. Accel	PT	21–24	1100–1300	19	2:06
9. Cruise	16	24*	1300	28	2:34
10. Decel	PT	24–21	1300–1100	6	2:40
11. Cruise	16	21	1100	28	3:08
12. Decel	CT	21–0	1100–500†	12	3:20

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*Corresponds to 8 rear-wheel hp.
†Declutch and start timer for next idle mode.

TABLE B-17. SwRI RESULTS WITH PROPOSED ETHYL CLASS IV CYCLE

Repeat for a Total of Two Cycles

Vehicle: 1967 Chevrolet Stake — GVW: 30,000 lb
Engine: 1966 366 CID, V-8 — N/V: 61.6

Mode	Man. Vac, in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration sec	Cumulative Time, Min:Sec
1. Idle	20.0	0	550	27	0:27
2. Gear-2	PT	0–11	550–2700	9	0:36
3. Gear-3	PT	11–20	1730–2800	9	0:45
4. Gear-4	WOT	20–31	1900–2800	8	0:53
5. Gear-5	WOT	31–35	1900–2100	4.5	0:57.5
6. Decel	CT	35–21	2100–1300	16.5	1:14
7. Cruise	16.3	21	1300	33	1:47
8. Accel	PT	21–24	1300–1500	19	2:06
9. Cruise	16.4	24*	1500	28	2:34
10. Decel	PT	24–21	1500–1300	6	2:40
11. Cruise	16.3	21	1300	28	3:08
12. Decel	CT	21–0	1300–550†	12	3:20

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*Corresponds to 7 rear-wheel hp.
†Declutch and start timer for next idle mode.

TABLE B-18. SwRI RESULTS WITH CLASS IV EXPERIMENTAL CHASSIS DYNAMOMETER CYCLE*

Repeat for Total of Two Cycles

Vehicle: 1966 IHC LS 1700 Stake — GVW: 24,000 lb
Engine: 345 CID, V-8 — N/V: 56.2

Dynamometer Initial Conditions: At 30 mph in fourth gear, conditions were 14 rear-wheel hp, 16 in. Hg intake manifold vacuum at 2350-rpm engine speed.

Mode	Man. Vac, in. Hg	Rear Wheels' Speed, mph	Engine, rpm	Duration, sec	Cumulative Time, Min:Sec
1. Idle	18	0	600	27†	0:27†
2. Gear-2	WOT	0–11	600–2200	5.5	0:32.5
3. Gear-3	WOT	11–20	1600–2500	5.5	0:38
4. Gear-4	WOT	20–31	1600–2400	12	0:50
5. Gear-5	WOT	31–35	1650–1900	7.5	0:57.5
6. Decel (With brakes if necessary)	CT	35–21	1900–1200	24	1:21.5
7. Cruise	16	21	1200	25.5	1:47†
8. Accel	PT	21–24	1200–1300	19†	2:06†
9. Cruise	16	24	1300	28†	2:34†
10. Decel	PT	24–21	1300–1150	6†	2:40†
11. Cruise	16	21	1150	28†	3:08†
12. Decel	CT‡	21–0	1150–600	12†	3:20†

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*As specified by R. Olsen and R. Springer per August 17, 1967, discussions.
†Time specified must be met.
‡Declutch at 3:20 and allow engine to idle (start time for next cycle, mode 1 - use brakes to slow to stop).

TABLE B-19. SwRI RESULTS WITH CLASS IV EXPERIMENTAL CHASSIS DYNAMOMETER CYCLE*

Repeat for a Total of Two Cycles

Vehicle: 1967 Chevrolet Stake	GVW: 30,000 lb
Engine: 1966 366 CID, V-8	N/V: 61.6

Dynamometer Initial Conditions: At 30 mph in fourth gear, conditions were 12 rear-wheel hp, 16 in. Hg intake manifold vacuum at 2650 rpm engine speed.

Mode	Man. Vac., in. Hg	Rear Wheels' Speed, mph	Engine rpm	Duration sec	Cumulative Time, Min:Sec
1. Idle	19.5	0	520	27†	0:27†
2. Gear-2	WOT	0–11	520–2600	4.5	0:31.5
3. Gear-3	WOT	11–20	1800–2700	4	0:35.5
4. Gear-4	WOT	20–31	1900–2800	8.5	0:44
5. Gear-5	WOT	31–35	1900–2100	6	0:50
6. Decel (With brakes if necessary)	CT	35–21	2100–1300	13	1:03
7. Cruise	16.3	21	1300	44	1:47†
8. Accel	PT	21–24	1300–1500	19†	2:06†
9. Cruise	16.4	24	1500	28†	2:34†
10. Decel	PT	24–21	1475–1300	6†	2:40†
11. Cruise	16.3	21	1300	28†	3:08†
12. Decel	CT‡	21–0	1300–500	12†	3:20†

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*As specified by B. Olsen and K. Springer per August 17, 1967, discussions.
†Time specified must be met.
‡Declutch at 3:20 and allow engine to idle (start time for next cycle, mode 1 – use brakes to slow to stop).

APPENDIX C

CLASS II TRUCK EXHAUST EMISSION RESULTS

TABLE C-1. CLASS II EXHAUST EMISSIONS FOR COMPARISON WITH DLA ROAD COURSE RESULTS

Vehicle: 1969 Chevrolet Stake
Engine: 250 CID, L6
Date: September 6-9, 1969

Sampler: Servoproportional
Cycle: Experimental Twelve-Mode
Fuel: Indolene

Load Condition	Run No.	HC(IR), ppm C	HC(FIA), ppm C	NO_x, ppm	CO, %	CO_2, %	HC(IR), lb/mi	HC(FIA), lb/mi	NO_2, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCF/mi
Level	1	7090	13,000	1345	2.74	11.42	0.0225	0.0458	0.0140	0.1640	1.209	13.60	12.50	13.05	92.4
	2	6100	11,850	1260	2.76	11.39	0.0201	0.0391	0.0138	0.1835	1.185	13.60	12.45	13.05	91.9
	3	6450	12,800	1085	2.42	11.05	0.0208	0.0388	0.0117	0.1585	1.135	13.70	12.30	13.00	90.0
	4	6220	13,100	1290	2.90	11.80	0.0190	0.0396	0.0125	0.1765	1.095	13.14	12.80	13.15	81.1
	5	5640	11,400	1230	3.29	10.65	0.0185	0.0375	0.0134	0.2185	1.115	13.40	12.10	12.75	91.5
	6	6260	11,800	1225	2.55	11.00	0.0206	0.0390	0.0135	0.1700	1.150	13.70	12.30	13.00	91.4
	7	6950	12,900	1140	3.00	10.10	0.0224	0.0416	0.0134	0.1985	1.045	13.50	11.80	12.65	90.5
	Max	7090	13,000	1345	3.29	11.89	0.0225	0.0458	0.0140	0.2185	1.209	13.70	12.80	13.15	92.4
	Min	5640	11,400	1085	2.42	10.10	0.0185	0.0375	0.0117	0.1585	1.045	13.40	11.80	12.65	81.1
	Avg	6430	12,476	1227	2.82	11.06	0.0207	0.0402	0.133	0.1827	1.133	13.57	12.32	12.94	89.8
Slight Uphill	1	4360	8,740	1200	2.65	11.40	0.0164	0.0349	0.0159	0.213	1.440	13.60	12.50	13.05	[illegible]
	2	4295	9,060	1140	2.54	11.65	0.0171	0.0357	0.0149	0.222	1.460	13.70	12.65	13.17	108.5
	3	4062	8,730	1210	2.71	12.64	0.0161	0.0349	0.0161	0.234	1.605	13.70	13.20	13.45	111.0
	4	4040	8,680	1170	2.68	11.55	0.0162	0.0347	0.0155	0.216	1.460	13.65	12.60	13.12	111.0
	Max	4360	9,060	1210	2.71	12.64	0.0171	0.0357	0.0161	0.234	1.605	13.70	13.20	13.45	111.0
	Min	4040	8,680	1140	2.54	11.40	0.0161	0.0347	0.0149	0.212	1.446	13.60	12.50	13.05	108.5
	Avg	4245	8,805	1180	2.65	11.81	0.0164	0.0350	0.0156	0.221	1.491	13.66	12.74	13.20	110.6
Uphill	1	4810	9,550	1249	2.94	10.14	0.0199	0.0396	0.0172	0.246	1.335	13.55	11.80	12.69	115.0
	2	5600	10,890	1300	3.26	10.97	0.0229	0.0431	0.0187	0.268	1.425	13.40	12.30	12.85	113.2
	3	5265	10,310	1550	2.91	11.85	0.0211	0.0428	0.0213	0.244	1.560	13.55	12.60	13.11	112.0
	4	5250	10,270	1400	2.93	12.45	0.0214	0.0422	0.0189	0.241	1.610	13.50	13.10	13.30	113.0
	Max	5600	10,890	1550	3.26	12.45	0.0229	0.0431	0.0213	0.268	1.610	13.55	13.10	13.30	115.0
	Min	4810	9,550	1249	2.91	10.14	0.0199	0.0396	0.0172	0.241	1.335	13.40	11.80	12.85	112.0
	Avg	5231	10,265	1399	3.01	11.35	0.0215	0.0420	0.0190	0.250	1.483	13.50	12.50	13.06	113.4

TABLE C-2. CLASS II EXHAUST EMISSIONS LEVEL ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1969 Chevrolet Sedan
Engine: 250 CID, L6
Date: September 5, 1969

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sampler	HC-SR, ppm C	HC-FIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HC-SR, lb/mi	HC-FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCFM
1	Proportional	7890	13,880	1345	2.74	11.42	0.0225	0.0458	0.0040	0.1840	1.205	13.60	12.50	13.05	92.4
2		6200	11,852	1260	2.76	11.30	0.0200	0.0380	0.0036	0.1825	1.185	13.60	12.45	13.05	91.9
3		6450	12,080	1085	2.42	11.05	0.0200	0.0380	0.0027	0.1585	1.135	13.70	12.30	13.00	90.5
4		6520	13,440	1290	2.98	11.80	0.0190	0.0396	0.0025	0.1760	1.085	13.50	12.80	13.15	81.1
5		5640	11,400	1230	3.29	10.65	0.0185	0.0375	0.0034	0.2185	1.115	13.40	12.10	12.75	91.5
6		6260	11,880	1225	2.95	11.08	0.0206	0.0398	0.0035	0.1700	1.150	13.70	12.30	13.00	91.4
7		6450	12,002	1240	3.01	10.10	0.0224	0.0426	0.0034	0.1995	1.045	13.50	11.80	12.65	90.5
Max		7890	13,880	1345	3.29	11.80	0.0225	0.0458	0.0040	0.2185	1.205	13.70	12.80	13.15	92.4
Min		5640	11,400	1085	2.42	10.10	0.0185	0.0375	0.0017	0.1585	1.045	13.40	11.80	12.65	81.1
Avg		6430	12,476	1227	2.87	11.04	0.0207	0.0402	0.0033	0.1834	1.133	13.57	12.32	12.95	89.8
1	Variable Dilution	330	570	92.5	0.170	0.60	0.0257	0.0379	0.0204	0.2280	1.300				104.5
2		310	550	92.5	0.175	0.60	0.0075	0.0360	0.0090	0.2320	1.350				100.0
3		380	630	86.9	0.165	0.60	0.0249	0.0419	0.0187	0.2220	1.264				109.5
4		340	610	92.5	0.176	0.60	0.0220	0.0402	0.0203	0.2260	1.256				108.5
5		320	590	75.0	0.175	0.65	0.0165	0.0362	0.0054	0.2210	1.360				112.5
6		340	610	92.5	0.165	0.60	0.0194	0.0389	0.0205	0.2180	1.240				108.5
7		330	600	92.5	0.180	0.55	0.0096	0.0363	0.0098	0.2355	1.130				94.3
Max		380	630	92.5	0.180	0.65	0.0249	0.0419	0.0205	0.2355	1.360				112.5
Min		310	550	75.0	0.165	0.55	0.0075	0.0360	0.0054	0.2180	1.130				94.3
Avg		326	597	88.9	0.171	0.60	0.0202	0.0382	0.0152	0.2275	1.294				106.3

Note: Variable dilution concentration values are not adjusted for diluent air contamination. Mass emissions in lb/mi are adjusted for influence of background.

TABLE C-5. CLASS I[illegible]AUST EMISSIONS—SLIGHT UPHILL ROAD LOAD CORRELATION
OF SER[illegible]PROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1969 Chevrolet Sedan
Engine: 250 CID, I-6
Date: September 6, 1968

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sampler	HC/IR, ppmC	HC/FIA, ppmC	NO_x, ppm	CO, %	CO_2, %	HC/IR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, avg	Exhaust Flow, SCF/mi
1	Proportional	4160	6740	1290	2.65	11.40	0.0166	0.0349	0.0129	0.213	1.440	13.60	12.50	13.05	111.0
2		4340	9060	1140	2.54	11.65	0.0171	0.0357	0.0146	0.202	1.460	13.70	12.65	13.17	109.5
3		4400	6720	1210	2.71	12.64	0.0161	0.0349	0.0161	0.214	1.605	13.70	13.20	13.45	111.1
4		4440	9640	1170	2.68	11.55	0.0162	0.0347	0.0155	0.216	1.460	13.65	12.60	13.12	111.0
Max		4340	9060	1210	2.71	12.64	0.0171	0.0357	0.0161	0.216	1.605	13.70	13.20	13.45	111.1
Min		4000	9680	1140	2.54	11.40	0.0161	0.0347	0.0149	0.202	1.440	13.60	12.50	13.05	109.5
Avg		4160	8005	1198	2.65	11.81	0.0164	0.0350	0.0156	0.211	1.491	13.66	12.74	13.20	110.6
1	Variable Dilution	330	590	1080.0	0.19	0.70	0.0181	0.0389	0.0220	0.254	1.470				115.0
2		330	600	684	0.19	0.70	0.0188	0.0391	0.0152	0.254	1.470				121.0
3		350	590	684	0.19	0.70	0.0196	0.0389	0.0152	0.254	1.470				122.0
4		330	570	684	0.18	0.70	0.0179	0.0366	0.0152	0.238	1.460				119.0
Max		350	620	1080.0	0.19	0.70	0.0196	0.0391	0.0220	0.254	1.470				122.0
Min		330	570	684	0.18	0.70	0.0179	0.0366	0.0152	0.238	1.460				115.0
Avg		335	590	772	0.19	0.70	0.0186	0.0384	0.0169	0.250	1.470				119.3

Note: Variable dilution concentration values are not adjusted for dilute air contaminations. Mass emissions in lb/mi are adjusted for influence of background.

TABLE C-4. CLASS B EXHAUST EMISSIONS—UPHILL ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHOD

Vehicle: 1968 Chevrolet Stake
Engine: 250 CID, I-6
Date: September 9, 1969

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sampler	HCDI, ppm C	HCFIA, ppm C	NO$_x$, ppm	CO, %	CO$_2$, %	HCDI, lb/mi	HCFIA, lb/mi	NO$_x$, lb/mi	CO, lb/mi	CO$_2$, lb/mi	Air/Fuel, CO	Air/Fuel, CO$_2$	Air/Fuel, Avg	Exhaust Flow, SCF/mi
1	Proportional	4810	9,550	1249	2.96	10.14	0.0199	0.0396	0.0172	0.246	1.335	13.55	11.80	12.80	115.0
2		5600	10,880	1390	3.26	10.97	0.0229	0.0423	0.0187	0.268	1.425	13.40	12.30	12.85	113.2
3		5265	10,310	1550	2.91	11.95	0.0218	0.0428	0.0213	0.244	1.560	13.35	12.90	13.12	115.0
4		5250	10,320	1400	2.93	12.45	0.0214	0.0422	0.0169	0.241	1.610	13.50	13.10	13.30	113.0
Max		5600	10,880	1550	3.26	12.45	0.0229	0.0423	0.0213	0.268	1.610	13.55	13.10	13.30	115.0
Min		4810	9,550	1249	2.91	10.14	0.0199	0.0396	0.0172	0.241	1.335	13.40	11.80	12.85	113.0
Avg		5231	10,265	1396	3.01	11.38	0.0215	0.0420	0.0190	0.250	1.483	13.50	12.50	13.04	114.1
1	Variable Dilution	330	590	108.0	0.230	0.89	0.0182	0.0394	0.0222	0.310	1.780				143.5
2		345	575	107.6	0.230	0.86	0.0190	0.0379	0.0235	0.305	1.670				137.0
3		355	590	125.2	0.220	0.90	0.0200	0.0394	0.0273	0.296	1.695				140.0
4		340	575	115.2	0.230	0.90	0.0186	0.0377	0.0251	0.305	1.665				136.4
Max		355	590	125.2	0.230	0.90	0.0200	0.0394	0.0273	0.310	1.780				143.5
Min		330	575	108.0	0.220	0.86	0.0182	0.0377	0.0222	0.296	1.665				136.4
Avg		342	582	111.6	0.228	0.89	0.0190	0.0386	0.0245	0.304	1.683				139.2

Note: Variable dilution concentrations—ppm, ppm C, %—are adjusted for dilute air contaminations. Mass emissions in lb/mi are adjusted for influence of background.

TABLE C-5. SUMMARY OF CLASS II EXHAUST EMISSIONS UNDER 1970 FEDERAL HEAVY DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1968 Chevrolet Stake	Cycle: Federal
Engine: 250 CID	Sampler: Continuous System
Date: August 7 & 8, 1968	Fuel: Indolene

Run No.	Emission	Cold Cycle, Avg	Hot Cycle, Avg	Weighted Composite, Avg
1	HC, ppm	314.55	351.76	338.7
	CO, %	2.66	2.67	2.67
2	HC, ppm	326.45	352.20	343.8
	CO, %	2.55	2.69	2.64
3*	HC, ppm	360.86	361.72	360.7
	CO, %	2.71	2.83	2.79
4	HC, ppm	340.87	358.77	352.5
	CO, %	2.77	2.83	2.81

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*Most representative four-cycle concentration run data presented in Table 6 of this appendix.

TABLE C-6. CLASS II EXHAUST EMISSIONS UNDER THE 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

(Representative Mode Data, Run 3)

Vehicle: 1965 Chevrolet Stake
Engine: 250 CID, L6
Date: August 8, 1968

Sampler: Continuous System
Cycle: Federal
Fuel: Indolene

Cycle No. 1

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC Wtd	CO Wtd
1	300	5.80	11.50	1.022	300.60	5.812	10.87	0.2093
2	155	0.35	14.20	1.005	155.78	0.352	13.86	0.0313
3	105	0.30	13.45	1.063	111.62	0.319	28.69	0.820
4	120	0.35	13.95	1.025	123.00	0.359	10.95	0.320
5	185	1.30	14.50	0.995	184.08	1.294	8.63	0.0608
6	155	0.45	14.50	0.983	152.37	0.442	13.56	0.0393
7	220	7.40	10.60	1.025	225.50	7.585	61.82	2.1466
8	155	0.50	14.50	0.983	152.37	0.492	13.56	0.0438
9	5110	5.75	6.05	1.631	8383.31	9.807	173.95	0.2059
Total							337.86	2.851

Cycle No. 2

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC Wtd	CO Wtd
1	300	5.80	11.50	1.002	300.60	5.812	10.82	0.2092
2	185	0.45	14.50	0.984	182.04	0.443	16.20	0.0394
3	120	0.30	13.70	1.046	125.52	0.314	12.26	0.0807
4	165	0.35	14.50	0.985	162.52	0.345	14.47	0.0307
5	210	1.55	14.70	0.965	202.65	1.496	9.53	0.703
6	175	0.60	14.50	0.978	171.15	0.587	15.23	0.0522
7	210	7.25	10.60	1.017	213.57	7.373	60.44	2.0866
8	165	0.55	14.80	0.959	158.24	0.527	14.08	0.0469
9	5060	3.65	6.20	1.608	8136.48	5.870	170.87	0.0773
Total							343.89	2.693
Average Cold Cycle Concentration							340.87	2.706

Cycle No. 3

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC Wtd	CO Wtd
1	175	6.45	11.00	1.011	179.13	6.521	13.65	0.2348
2	230	0.55	14.50	0.979	225.17	0.538	30.04	0.0479
3	120	0.30	13.70	1.045	125.40	0.314	12.23	0.0807
4	175	0.55	14.50	0.980	171.50	0.539	15.35	0.0480
5	195	1.50	13.95	0.986	192.27	1.479	9.06	0.0695
6	175	0.60	14.50	0.976	170.80	0.586	15.20	0.0522
7	230	7.40	10.60	1.010	232.30	7.474	65.74	2.1151
8	175	0.55	14.50	0.979	171.33	0.538	15.25	0.0479
9	5070	3.70	6.00	1.638	8304.66	6.061	174.40	0.1273
Total							360.81	2.823

Cycle No. 4

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC Wtd	CO Wtd
1	175	6.45	11.00	1.011	179.88	6.534	13.68	0.2152
2	210	0.70	14.50	0.974	204.54	0.682	18.20	0.0607
3	120	0.30	13.70	1.045	125.40	0.314	12.23	0.0807
4	175	0.50	14.50	0.981	171.68	0.491	15.28	0.0437
5	220	1.70	14.20	0.961	211.42	1.634	9.94	0.0768
6	185	0.60	14.50	0.976	180.56	0.586	16.07	0.0522
7	245	7.40	10.60	1.010	247.45	7.474	70.03	2.1151
8	195	0.70	14.50	0.975	190.13	0.683	16.92	0.0608
9	5050	3.60	6.00	1.550	7827.50	5.580	164.38	0.1173
Total							356.73	2.842
Average Hot Cycle Concentration							361.72	2.832

Four-Cycle Composite Emissions:
Hydrocarbons - 360.7 ppm
Carbon Monoxide - 2.78

TABLE C-7. CLASS II EXHAUST EMISSIONS UNDER 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1968 Chevrolet Stake
Engine: 250 CID, I-6
Date: August 7 & 8, 1968

Sampler: Variable Dilution
Cycle: Federal
Fuel: Indolene

Run No.	HC/IR, ppm C	HC/FIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HC/IR, lb/mi	HC/FIA, lb/mi	NO_2, lb/mi	CO, lb/mi	CO_2, lb/mi	Exhaust Flow, SCF/mi
1	150	275	154	0.230	0.80	0.00600	0.01200	0.0219	0.194	1.090	77.0
2	160	300	146	0.165	0.81	0.00638	0.01270	0.0206	0.141	1.088	79.2
3	170	300	146	0.160	0.80	0.00665	0.01240	0.0201	0.134	1.050	76.0
4	150	300	146	0.170	0.80	0.00552	0.01250	0.0203	0.143	1.060	78.0
Max	170	300	154	0.230	0.81	0.00665	0.01270	0.0219	0.194	1.090	79.2
Min	150	275	146	0.160	0.80	0.00552	0.01200	0.0201	0.134	1.050	76.0
Avg	158	294	148	0.181	0.80	0.00614	0.01240	0.0207	0.154	1.072	77.6

Note: Variable dilution concentration values are not adjusted for diluent contamination. Mass emission values as lb/mi are adjusted for influence of background air.

TABLE C-6. CLASS III EXHAUST EMISSIONS FOR CORRELATION WITH DLA ROAD-COURSE RESULTS

Vehicle: 1965 Chevrolet Van
Engine: 292-cu in. 6-cylinder
Date: September 5-6, 1967

Sampler: Servoproportional
Cycle: Experimental Nine-Mode
Fuel: Indolene

Load Conditions	Run No.	HC(IR), ppm C	HC(FIA), ppm C	NO_x, ppm	CO, %	CO_2, %	HC(IR), lb/mi	HC(FIA), lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCFM
Level	1	5125	9620	1040	4.41	11.52	0.0259	0.0487	0.0176	0.411	1.855	13.08	12.60	12.85	140.5
	2	5870	9260	1059	4.09	11.61	0.0287	0.0452	0.0172	0.384	1.680	13.20	12.61	12.90	139.5
	3	5630	9750	1100	4.05	11.45	0.0281	0.0486	0.0182	0.405	1.805	13.18	12.55	12.88	138.5
	4	5380	8750	1151	3.82	11.50	0.0258	0.0418	0.0183	0.379	1.755	13.20	12.60	12.90	135.0
	5	5400	9010	1091	3.95	11.47	0.0262	0.0436	0.0173	0.376	1.745	13.25	12.70	13.00	133.2
	Max	5870	9750	1153	4.41	11.63	0.0287	0.0487	0.0183	0.425	1.855	13.25	12.76	13.00	140.5
	Min	5125	8750	1040	3.82	11.45	0.0258	0.0418	0.0172	0.376	1.745	13.08	12.55	12.85	133.0
	Avg	5549	9290	1090	4.06	11.54	0.0269	0.0455	0.0177	0.395	1.792	13.15	12.61	12.90	136.1
Slight Uphill	1	4740	8030	1560	3.77	11.41	0.0261	0.0432	0.0284	0.419	1.990	13.20	12.5	12.8	152.5
	2	4730	8350	1547	3.78	11.32	0.0265	0.0470	0.0299	0.430	2.250	13.30	12.4	12.8	156.5
	3	4830	8460	1405	3.75	11.25	0.0244	0.0461	0.0256	0.424	1.955	13.25	12.4	12.9	151.5
	Max	4830	8460	1560	3.78	11.41	0.0265	0.0470	0.0299	0.430	2.250	13.30	12.50	12.9	156.5
	Min	4730	8030	1405	3.75	11.25	0.0244	0.0432	0.0256	0.419	1.955	13.20	12.40	12.8	151.5
	Avg	4773	8280	1506	3.76	11.32	0.0257	0.0457	0.0280	0.424	2.06	13.25	12.43	12.8	153.5
Uphill	1	3900	6920	900	4.94	10.92	0.0275	0.0488	0.0211	0.704	2.45	12.80	12.25	12.53	196
	2	3900	7320	1085	4.54	11.25	0.0270	0.0541	0.0240	0.611	2.36	12.90	12.40	12.65	194
	3	4275	7300	1245	4.60	11.25	0.0286	0.0490	0.0279	0.625	2.40	12.90	12.40	12.60	197
	Max	4275	7320	1245	4.94	11.25	0.0286	0.0541	0.0279	0.704	2.45	12.90	12.40	12.65	197
	Min	3900	6920	900	4.54	10.92	0.0270	0.0488	0.0211	0.611	2.36	12.80	12.25	12.53	194
	Avg	4025	7180	1080	4.69	11.10	0.0277	0.0506	0.0243	0.647	2.40	12.87	12.35	12.58	196

TABLE C-9. CLASS III EXHAUST EMISSIONS—ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1965 Chevrolet Van
Engine: 292-cu in., 6-cylinder
Date: January 8, 1968

Cycle: Experimental Nine-Mode
Fuel: Indolene

Run No.	Sample	HCIR, ppm C	HCFIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HCIR, lb/mi	HCFIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCF/mi
1	Proportional	5240	7,650	1460	3.81	11.43	0.0262	0.0495	0.0244	0.384	1.650	13.20	12.60	12.90	1390
2		4840	9,770	1420	3.69	11.53	0.0240	0.0486	0.0235	0.369	1.612	13.25	12.60	12.92	1375
3		5400	10,160	1340	3.57	11.70	0.0264	0.0498	0.0218	0.362	1.600	13.30	12.67	12.98	1360
4		5790	10,590	1363	4.42	11.75	0.0251	0.0396	0.0213	0.334	1.700	13.00	12.70	12.85	1307
Max		5790	10,590	1460	4.42	11.75	0.0264	0.0498	0.0244	0.384	1.650	13.30	12.70	12.98	1390
Min		4840	9,770	1340	3.57	11.43	0.0240	0.0396	0.0213	0.334	1.700	13.00	12.60	12.85	1307
Avg		5400	10,690	1396	3.87	11.60	0.0255	0.0460	0.0227	0.362	1.700	13.19	12.64	12.91	1358
1	Variable Dilution	276	440	57.7	0.170	0.560	0.0291	0.0649	0.0194	0.346	1.805				
2		258	510	51.3	0.165	0.530	0.0267	0.0633	0.0176	0.346	1.742				
3		278	650	75.5	0.175	0.560	0.0312	0.0664	0.0255	0.360	1.805				
4		306	650	39.3	0.230	0.560	0.0310	0.0660	0.0132	0.472	1.805				
Max		306	650	75.5	0.230	0.560	0.0312	0.0664	0.0255	0.472	1.805				
Min		258	440	39.3	0.165	0.530	0.0267	0.0649	0.0132	0.347	1.742				
Avg		287	588	56.0	0.185	0.553	0.0295	0.0602	0.0189	0.382	1.794				

TABLE C-18. CLASS III EXHAUST EMISSIONS - SLIGHT LOAD/ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1965 Chevrolet Van
Engine: 292-cu in., 6-cylinder
Date: January 10, 1968

Cycle: Experimental/Non-Mode
Fuel: Indolene

Run No.	Sampler	HC/IR, ppm C	HC/FIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HC/IR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCFm
1	Proportional	4720	9000	1200	3.89	11.32	0.0257	0.0496	0.0219	0.428	1.960	13.20	12.50	12.85	1515
2		4403	7950	1240	4.51	11.40	0.0241	0.0434	0.0225	0.498	2.075	12.95	12.50	12.75	1520
3		5150	9630	1265	4.39	11.55	0.0271	0.0505	0.0224	0.467	1.920	13.04	12.60	12.80	1464
4		5004	9460	1370	4.16	11.50	0.0266	0.0492	0.0226	0.436	1.900	13.10	12.60	12.85	1465
Max		5150	9630	1370	4.51	11.55	0.0271	0.0505	0.0226	0.498	2.075	13.20	12.60	12.85	1520
Min		4403	7950	1200	3.89	11.32	0.0241	0.0434	0.0219	0.428	1.900	12.95	12.50	12.75	1465
Avg		4822	9030	1274	4.24	11.45	0.0260	0.0482	0.0224	0.457	1.964	13.06	12.55	12.80	1483
1	Variable Dilution	306	635	53.0	0.225	0.68	0.0310	0.0645	0.0178	0.461	2.180				
2		312	630	53.0	0.245	0.68	0.0308	0.0657	0.0176	0.496	2.197				
3		258	620	69.4	0.230	0.64	0.0260	0.0625	0.0232	0.468	2.050				
4		270	650	69.4	0.215	0.64	0.0275	0.0636	0.0233	0.439	2.055				
Max		312	650	69.4	0.245	0.68	0.0310	0.0657	0.0233	0.496	2.197				
Min		258	620	53.0	0.215	0.64	0.0260	0.0625	0.0176	0.439	2.050				
Avg		287	636	61.2	0.229	0.66	0.0288	0.0640	0.0205	0.466	2.120				

TABLE C-11. CLASS III EXHAUST EMISSIONS—UPHILL LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1965 Chevrolet Van
Engine: 292-cu in. 6-cylinder
Date: January 11,1968

Cycle: Experimental Max-Mode
Fuel: Indolene

Run No.	Sampler	HCIR, ppm C	HCFIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HCIR, lb/mi	HCFIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCF/mi
1	Proportional	4250	9800	830	5.46	11.10	0.0266	0.0575	0.0177	0.781	2.26	12.65	12.48	12.55	1780
2		3995	8820	805	5.22	10.50	0.0258	0.0592	0.0177	0.697	2.21	12.78	12.08	12.35	1862
3		4060	9800	966	4.63	10.85	0.0264	0.0578	0.0195	0.607	2.24	12.90	12.20	12.50	1815
4		4520	9525	830	4.82	10.96	0.0275	0.0601	0.0178	0.629	2.22	12.65	12.28	12.52	1790
Max		4520	9525	966	5.46	11.10	0.0275	[illegible]	0.0195	0.781	2.26	12.90	12.48	12.55	1862
Min		3995	8800	805	4.63	10.50	0.0258	0.0575	0.0177	0.607	2.21	12.65	12.08	12.35	1780
Avg		4256	9036	862	5.07	10.86	0.0266	0.0586	0.0182	0.659	2.23	12.77	12.29	12.59	1804
1	Variable Dilution	312	690	40.6	0.34	0.68	0.0313	0.0680	0.0138	0.687	2.30				
2		312	735	40.6	0.34	0.70	0.0312	0.0726	0.0138	0.664	2.22				
3		312	690	46.2	0.34	0.70	0.0302	0.0680	0.0152	0.686	2.15				
4		312	690	23.5	.29	0.68	0.0326	0.0686	0.0077	0.588	2.17				
Max		312	735	46.2	0.345	0.70	0.0326	0.0726	0.0136	0.687	2.30				
Min		312	690	23.5	0.290	0.68	0.0302	0.0680	0.0077	0.588	2.15				
Avg		312	701	38.2	0.327	0.69	0.0315	0.0694	0.0126	0.656	2.21				

TABLE C-12. SUMMARY OF CLASS III EXHAUST EMISSIONS UNDER PROPOSED 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1965 Chevrolet Van	Sampler: Continuous System
Engine: 292-cu in., 6-cylinder	Cycle: Federal
Date: February 29-March 1, 1968	Fuel: Indolene

Run No.	Emissions	Cold Cycle, Avg	Hot Cycle, Avg	Weighted Composite, Avg
1	HC, ppm	279.2	308.9	289.1
	CO, %	3.07	3.23	3.17
2	HC, ppm	264.13	351.1	351.1
	CO, %	3.16	3.67	3.49
3	HC, ppm	250.87	240.47	244
	CO, %	3.05	3.36	3.36
4	HC, ppm	249.87	241.68	245.1
	CO, %	3.00	3.14	3.09
5	HC, ppm	206.2	237.2	231.5
	CO, %	2.97	3.38	3.13
6[a]	HC, ppm	240.21	258.58	251.7
	CO, %	3.03	3.40	3.23
7	HC, ppm	221.38	231.66	228
	CO, %	3.07	3.34	3.24
8	HC, ppm	211.10	227.5	221.5
	CO, %	3.10	3.41	3.29

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[a] Most representative four-cycle concentration runs data presented in Table C-6.

TABLE C-13. CLASS III EXHAUST EMISSIONS UNDER PROPOSED 1970 FEDERAL HEAVY-DUTY TRUCK PROCEDURE

(Representative Mode Data, Run 6)

Vehicle: 1965 Chevrolet Van
Engine: 292 cu in., 6-cylinder
Date: March 1, 1968

Sampler: Continuous System
Cycle: Federal
Fuel: Indolene

Cycle No. 1

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WID	CO WID
1	235	8.17	8.25	1.195	280.8	9.763	10.11	0.351
2	143	0.23	14.00	1.053	150.6	0.242	13.40	0.021
3	140	0.80	13.82	1.046	146.4	0.836	17.62	0.214
4	107	0.30	14.03	1.047	112.0	0.314	9.97	0.027
5	165	1.15	14.00	1.023	168.8	0.117	7.93	0.054
6	100	0.23	14.02	1.053	105.3	0.242	9.37	0.021
7	173	7.30	10.6	1.074	185.8	7.732	52.58	2.188
8	85	0.50	14.30	1.025	87.1	0.512	7.75	0.045
9	3325	3.81	5.91	1.345	4472.1	5.124	93.91	0.107
Total							242.64	3.028

Cycle No. 2

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WID	CO WID
1	235	8.17	8.25	1.195	280.8	9.763	10.11	0.351
2	105	0.35	14.20	1.036	108.8	0.362	9.68	0.012
3	107	0.72	14.02	1.036	110.8	0.745	28.47	0.194
4	85	0.40	14.12	1.027	87.3	0.410	7.77	0.036
5	165	1.02	14.20	1.008	166.3	0.102	7.82	0.047
6	95	0.40	14.20	1.035	98.3	0.44	8.74	0.036
7	165	7.40	10.50	1.045	172.4	7.733	48.79	2.188
8	75	0.65	13.95	1.045	78.4	0.679	6.98	0.060
9	3805	3.82	5.23	1.370	5212.8	5.233	109.46	0.109
Total							237.82	3.023
Average Cold Cycle Concentration							240.23	3.025

Cycle No. 3

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WID	CO WID
1	405	9.65	7.22	1.205	488.0	11.62	17.56	0.418
2	105	0.54	14.10	1.037	108.9	0.559	9.69	0.049
3	110	1.00	14.00	1.027	113.0	1.027	29.04	0.263
4	95	0.75	13.95	1.042	99.0	0.781	8.81	0.069
5	240	1.75	13.65	1.015	243.6	1.776	11.45	0.083
6	95	0.52	14.20	1.033	98.1	0.537	8.73	0.047
7	165	7.40	10.50	1.046	172.6	7.740	48.85	2.190
8	95	0.75	14.10	1.032	98.0	0.774	8.72	0.068
9	4010	3.85	5.24	1.343	5385.4	5.170	113.09	0.108
Total							255.94	3.295

Cycle No. 4

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WID	CO WID
1	405	9.65	7.22	1.205	488.0	11.62	17.50	0.418
2	130	0.70	13.95	1.042	135.5	0.729	12.36	0.064
3	120	1.35	13.82	1.077	12.32	1.356	31.66	0.356
4	115	0.95	14.00	1.027	118.1	0.976	10.51	0.086
5	170	0.50	14.10	1.034	175.8	0.517	9.26	0.024
6	90	0.45	14.07	1.043	93.9	0.469	8.36	0.041
7	165	7.47	10.40	1.049	173.1	7.836	48.99	2.217
8	95	0.78	14.07	1.032	98.0	0.804	8.72	0.071
9	4150	3.91	5.23	1.321	5482.1	5.165	115.13	0.108
Total							261.15	3.385
Average Hot Cycle Concentration							258.54	3.340

Four-Cycle Composite Emission:
Hydrocarbon 251.7 ppm
Carbon Monoxide 3.733

TABLE C-14. CLASS III EXHAUST EMISSIONS UNDER PROPOSED 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1965 Chevrolet Van
Engine: 292-cu in., 6-cylinder
Date: March 5, 1969

Sampler: Variable Dilution
Cycle: Federal
Fuel: Indolene

Run No.	HCDR, ppm C	HCFIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HCDR, lb/mi	HCFIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi
1	228	365	127	0.21	1.1	0.0135	0.0215	0.0250	0.250	2.066
2	228	365	150	0.21	1.1	0.0131	0.0209	0.0285	0.243	2.000
3	240	374	127	0.21	1.1	0.0143	0.0227	0.0252	0.254	2.085
4	240	400	127	0.21	1.1	0.0140	0.0234	0.0247	0.247	2.046
Max	240	400	150	0.21	1.1	0.0143	0.0234	0.0285	0.254	2.085
Min	228	365	127	0.21	1.1	0.0131	0.0209	0.0247	0.243	2.000
Avg	234	376	133	0.21	1.1	0.0137	0.0221	0.0259	0.249	2.046

TABLE C-15. CLASS IV EXHAUST EMISSIONS FOR CORRELATION WITH DLA ROAD-COURSE RESULTS

Vehicle: 1966 IHC Cabe
Engine: 345-cu in., V-8
Date: September 6, 1967 and January 17, 1968

Sampler: Servoproportional
Cycle: Experimental Twelve-Mode
Fuel: Indolene

Load Conditions	Run No.	HCDR, ppm C	HCFIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HCDR, lb/mi	HCFIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCF/mi
Level	1	4560	9300	732	3.93	11.15	0.0236	0.0482	0.0126	0.412	2.295	13.15	12.40	12.78	1461.2
	2	4620	9660	738	4.10	11.25	0.0234	0.0491	0.0125	0.421	2.340	13.10	12.40	12.75	1461.3
	3	4530	9570	752	4.17	11.46	0.0229	0.0484	0.0126	0.426	2.025	13.10	12.55	12.82	1485.5
	4	4675	9550	796	4.05	11.45	0.0244	0.0499	0.0131	0.426	2.110	13.12	12.55	12.83	1464.8
	Max	4675	9660	796	4.17	11.46	0.0244	0.0499	0.0131	0.426	2.340	13.15	12.55	12.85	1464.8
	Min	4530	9300	732	3.93	11.15	0.0229	0.0482	0.0125	0.412	2.025	13.10	12.40	12.75	1461.5
	Avg	4596	9520	754	4.06	11.32	0.0236	0.0479	0.0127	0.421	2.110	13.12	12.48	12.79	1462.7
Slight Uphill	1	4175	8275	786	3.86	12.10	0.0236	0.0468	0.0133	0.467	2.38	13.2	12.90	13.05	1557.5
	2	3470	7360	655	3.78	11.40	0.0194	0.0411	0.0125	0.428	2.05	13.2	12.50	12.85	1555.5
	3	4590	8620	610	3.67	11.60	0.0263	0.0485	0.0116	0.426	2.22	13.3	12.65	12.98	1558.5
	4	3800	8650	620	3.86	11.50	0.0222	0.0470	0.0120	0.448	2.13	13.2	12.60	12.90	1622.8
	5	4280	8640	595	4.08	12.65	0.0265	0.0513	0.0116	0.481	2.40	13.1	13.25	13.18	1665.5
	Max	4590	8640	786	4.08	12.65	0.0265	0.0513	0.0133	0.481	2.40	13.3	13.25	13.18	1665.5
	Min	3470	7360	595	3.67	11.40	0.0194	0.0411	0.0116	0.426	2.05	13.1	12.50	12.85	1555.5
	Avg	4063	8155	657	3.85	11.65	0.0236	0.0469	0.0122	0.450	2.19	13.2	12.74	13.00	1600.0

TABLE C-16. CLASS IV EXHAUST EMISSIONS–ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1966 20C Stake
Engine: 345-cu.in. V-8
Date: January 17,1968

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sampler	HC/IR, ppm C	HC/FIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HC/IR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCFM
1	Proportional	4560	9300	732	3.93	11.15	0.0236	0.0462	0.0126	0.412	2.095	13.15	12.40	12.70	144.2
2		4610	9660	738	4.10	11.25	0.0234	0.0481	0.5125	0.421	2.140	13.10	12.40	12.75	141.3
3		4530	9570	752	4.17	11.46	0.0229	0.0486	0.0126	0.426	2.025	13.10	12.55	12.82	140.2
4		4675	9550	756	4.05	11.45	0.0244	0.0495	0.0127	0.425	2.110	13.12	12.55	12.85	144.0
Max		4675	9660	756	4.17	11.46	0.0244	0.0499	0.0131	0.426	2.140	13.15	12.55	12.85	144.0
Min		4530	9300	732	3.93	11.15	0.0229	0.0462	0.0125	0.412	2.025	13.10	12.40	12.75	140.5
Avg		4594	9520	744	4.06	11.32	0.0236	0.0485	0.0127	0.421	2.110	13.12	12.49	12.79	142.7
1	Variable Dilution	224	500	46.2	0.21	0.57	0.0246	0.0526	0.0161	0.446	1.980				
2		224	515	57.8	0.21	0.57	0.0245	0.0541	0.0201	0.446	1.890				
3		224	495	46.2	0.21	0.60	0.0247	0.0522	0.0161	0.456	2.095				
4		224	515	46.2	0.21	0.57	0.0252	0.0479	0.0165	0.456	2.025				
Max		224	515	57.8	0.21	0.60	0.0252	0.0541	0.0201	0.456	2.095				
Min		224	495	46.2	0.21	0.57	0.0245	0.0479	0.0161	0.406	1.890				
Avg		224	506	49.1	0.21	0.59	0.0248	0.0517	0.0172	0.438	1.980				

TABLE C-17. CLASS IV EXHAUST EMISSIONS—SLIGHT UPHILL ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1966 IHC Stake
Engine: 345-cu.in. V-8
Date: January 19, 1968

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sample	HCIR, ppm C	HCFIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HCIR, lb/mi	HCFIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCFM
1	Proportional	3400	7470	875	3.26	11.72	0.0216	0.0475	0.0184	0.416	2.362	13.40	12.30	12.35	176.5
2		3685	8125	956	3.04	12.00	0.0250	0.0552	0.0216	0.416	2.570	13.50	12.85	13.07	189.0
3		3195	7490	863	3.04	11.38	0.0193	0.0451	0.0175	0.370	2.180	13.56	12.56	13.00	167.5
4		3250	7160	800	3.00	10.75	0.0197	0.0434	0.0161	0.367	2.070	13.50	12.15	12.82	168.2
Max		3685	8125	956	3.26	12.00	0.0250	0.0552	0.0216	0.416	2.570	13.50	12.85	13.07	189.0
Min		3195	7160	800	3.00	10.75	0.0193	0.0434	0.0161	0.367	2.070	13.40	12.15	12.35	167.5
Avg		3382	7561	871	3.085	11.46	0.0204	0.0478	0.0184	0.392	2.295	13.46	12.46	12.59	175.3
1	Variable Dilution	229	495	57.8	0.195	0.75	0.0246	0.0537	0.0208	0.427	2.575				
2		229	515	57.8	0.175	0.75	0.0240	0.0542	0.0203	0.373	2.510				
3		229	495	46.2	0.175	0.71	0.0240	0.0522	0.0161	0.372	2.370				
4		229	500	46.2	0.195	0.75	0.0240	0.0578	0.0162	0.425	2.510				
Max		229	515	57.8	0.195	0.75	0.0246	0.0542	0.0208	0.427	2.575				
Min		229	495	46.2	0.175	0.71	0.0240	0.0520	0.0161	0.372	2.370				
Avg		229	501	52.0	0.185	0.74	0.0242	0.0552	0.0188	0.396	2.491				

TABLE C-16. SUMMARY OF CLASS IV EXHAUST EMISSIONS UNDER PROPOSED 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1966 IHC Stake	Sampler: Continuous System
Engine: 345 cu in., V-8	Cycle: Federal
Date: February 14, 15, and 20, 1968	Fuel: Indolene

Run No.	Emissions	Cold Cycle, Avg	Hot Cycle, Avg	Weighted Composite, Avg
1	HC, ppm	316.53	523.51	456.50
	CO, %	2.84	3.12	3.02
2*	HC, ppm	444.44	534.63	402.0
	CO, %	2.96	3.045	3.01
3	HC, ppm	398.98	367.09	378.0
	CO, %	2.94	3.21	3.11
4	HC, ppm	350.43	377.24	366.50
	CO, %	3.06	2.98	3.00
5	HC, ppm	424.36	378.64	394.0
	CO, %	3.05	3.20	3.14
6	HC, ppm	305.59	277.79	287.3
	CO, %	2.76	3.12	2.99
7	HC, ppm	360.74	456.20	422.0
	CO, %	3.28	3.46	3.38
8	HC, ppm	451.07	404.58	419.5
	CO, %	3.42	3.31	3.35

*Most representative four-cycle concentration run data presented in Table E-5.

TABLE C-19. CLASS IV EXHAUST EMISSIONS UNDER PROPOSED 1970 FEDERAL HEAVY-DUTY TRUCK PROCEDURE

(Representative Mode Data, Run 2)

Vehicle: 1966 IHC Stake
Engine: 345 cu in., V-8
Date: February 14, 1968

Sampler: Continuous System
Cycle: Federal
Fuel: Indolene

Cycle No. 1

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	1050	10.00	6.30	1.214	1274.7	12.14	45.89	0.451
2	210	1.72	13.80	1.015	213.2	1.74	14.97	0.137
3	150	1.92	13.75	1.014	152.1	1.94	39.09	0.498
4	180	2.36	13.40	1.021	183.8	2.40	16.54	0.213
5	175	3.47	12.85	1.021	178.7	3.54	8.40	0.166
6	150	1.78	13.78	1.017	152.6	1.81	13.58	1.61
7	130	3.56	12.65	1.034	134.4	3.60	38.03	1.041
8	130	1.95	13.33	1.043	135.6	2.03	12.07	1.79
9	7251	4.30	4.40	1.100	7976.1	4.73	167.50	0.099
Total							360.07	2.96

Cycle No. 2

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	1050	10.00	6.3	1.214	1274.7	12.14	45.89	0.451
2	405	1.77	13.95	0.998	404.2	1.76	35.97	0.156
3	350	1.82	13.95	0.998	349.3	1.81	89.77	0.465
4	345	2.62	13.33	1.085	374.3	2.87	33.31	0.255
5	325	3.20	13.07	1.085	352.6	3.47	16.57	0.163
6	295	2.00	13.70	1.085	320.1	2.17	28.49	0.191
7	260	3.62	13.25	0.990	257.4	3.58	77.84	1.013
8	235	2.10	13.50	1.022	240.2	2.14	21.37	0.190
9	9082	4.34	4.37	0.968	8791.3	4.20	184.61	0.088
Total							528.82	2.97
Average Cold Cycle Concentration							444.44	2.965

Cycle No. 3

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	1375	10.60	6.30	1.165	1601.9	12.35	57.37	0.461
2	530	2.15	13.82	0.988	523.6	2.12	46.60	0.188
3	375	1.98	14.04	0.975	365.6	1.93	93.95	0.496
4	360	2.25	13.74	0.997	358.9	2.24	31.94	0.199
5	345	2.80	13.32	1.005	346.7	2.81	16.29	0.117
6	320	2.50	13.70	0.993	317.7	2.48	28.27	0.220
7	310	3.85	12.95	0.998	401.5	3.84	113.63	1.086
8	310	2.27	13.68	1.002	309.4	2.27	27.54	0.202
9	6742	4.26	4.60	1.118	7537.6	4.76	158.28	0.099
Total							572.16	3.06

Cycle No. 4

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	1375	10.60	6.20	1.163	1601.9	12.81	57.67	0.461
2	490	2.06	13.90	0.987	483.7	2.03	43.04	0.180
3	390	1.79	13.95	0.998	389.2	1.78	100.02	0.457
4	355	2.56	13.20	1.021	362.7	2.61	32.26	0.232
5	345	2.87	13.40	0.999	344.6	2.87	16.19	0.134
6	335	2.46	13.70	0.994	332.9	2.44	29.63	0.217
7	210	3.80	13.10	0.992	208.3	3.76	58.95	1.064
8	195	2.30	13.57	1.007	196.3	2.31	17.47	0.205
9	7108	4.39	4.31	0.954	6781.0	4.18	142.40	0.087
Total							497.63	3.03
Average Hot Cycle Concentration							534.89	3.045

Four Cycle Composite Emission:
Hydrocarbon: 402 ppm
Carbon Monoxide: 3.01%

TABLE C-20. CLASS IV EXHAUST EMISSIONS UNDER PROPOSED 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1966 IHC Stake
Engine: 345 cu in., V-8
Date: February 14 and 15, 1968

Sampler: Constant Volume
Cycle: Federal
Fuel: Indolene

Run No.	HC/IR, ppm C	HC/FIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HC/IR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Exhaust Flow, SCF/mi
1	222	345	92.5	0.145	0.75	0.01590	0.0246	0.0219	0.209	1.70	
2	240	380	104.0	0.145	0.83	0.01725	0.0273	0.0248	0.212	1.89	
3	192	455	57.6	0.160	0.73	0.01470	0.0347	0.0140	0.247	1.77	
4	180	440	46.1	0.150	0.71	0.01445	0.0353	0.0123	0.224	1.81	
5	180	365	69.4	0.150	0.72	0.01420	0.0298	0.0161	0.238	1.81	
6	216	420	46.3	0.150	0.68	0.01760	0.0343	0.0136	0.248	1.76	
Max	240	455	104.0	0.160	0.83	0.01760	0.0353	0.0248	0.248	1.89	
Min	180	345	46.1	0.145	0.71	0.01420	0.0246	0.0123	0.209	1.70	
Avg	205	401	69.3	0.150	0.74	0.01568	0.0310	0.0173	0.230	1.79	119

TABLE C-21. CLASS IV EXHAUST EMISSIONS FOR CORRELATION WITH DLA ROAD COURSE RESULTS

Vehicle: 1967 Chevrolet Stake
Engine: 366-cu.in. V-8
Date: January 2, 3, 4, and 5, 1969

Sampler: Semiproportional
Cycle: Experimental Twelve-Mode
Fuel: Indolene

Load Condition	Run No.	HC(IR), ppm C	HC(FIA), ppm C	NO2, ppm	CO, %	CO2, %	HC(IR), lb/mi	HC(FIA), lb/mi	NO2, lb/mi	CO, lb/mi	CO2, lb/mi	Air/Fuel, CO	Air/Fuel, CO2	Air/Fuel, Avg	Exhaust Flow, SCFm
Level	1	4050	7150	1490	1.470	12.35	0.0226	0.0390	0.0264	0.156	2.090	14.20	13.10	13.60	1480.0
	2	3460	6410	1425	1.255	12.50	0.0192	0.0336	0.0251	0.134	2.095	14.20	13.05	13.70	1465.5
	3	3280	6350	1390	1.270	12.65	0.0178	0.0345	0.0236	0.139	2.100	14.20	13.20	13.70	1503.5
	4	3250	6250	1475	1.280	12.65	0.0164	0.0327	0.0256	0.127	2.100	14.25	13.20	13.70	1465.0
	Max	4050	7150	1490	1.470	12.65	0.0226	0.0390	0.0264	0.156	2.100	14.25	13.20	13.70	1503.5
	Min	3250	6250	1390	1.255	12.35	0.0164	0.0327	0.0236	0.127	2.090	14.20	13.10	13.60	1465.0
	Avg	3480	6540	1425	1.300	12.55	0.0196	0.0348	0.0252	0.139	2.095	14.19	13.16	13.69	1473.5
Slight Uphill	1	3640	6460	1630	1.450	12.50	0.0205	0.0364	0.0255	0.1650	2.24	14.15	13.15	13.65	1965.5
	2	4290	7250	1670	1.485	12.30	0.0235	0.0406	0.0289	0.1645	2.21	14.15	13.00	13.57	1955.5
	3	2890	5220	1670	1.445	12.65	0.0161	0.0290	0.0346	0.1675	2.24	14.15	13.20	13.66	1955.0
	4	2770	4980	1700	1.335	12.45	0.0155	0.0273	0.0370	0.1585	2.23	14.15	13.10	13.70	1955.0
	Max	4290	7250	1670	1.485	12.65	0.0235	0.0406	0.0346	0.1675	2.240	14.15	13.20	13.70	1965.5
	Min	2770	4980	1670	1.335	12.30	0.0155	0.0273	0.0255	0.1585	2.210	14.15	13.00	13.57	1955.0
	Avg	3375	5980	1660	1.431	12.40	0.0189	0.0333	0.0306	0.1619	2.225	14.15	13.11	13.64	1959.5
Moderate Uphill	1	2970	5400	1750	1.605	12.45	0.0182	0.0330	0.0356	0.196	2.42	14.07	13.10	13.70	1710.0
	2	2710	4760	1660	1.525	12.50	0.0166	0.0295	0.0382	0.181	2.46	14.10	13.10	12.70	1720.0
	3	2810	5010	1660	1.540	11.90	0.0174	0.0312	0.0340	0.192	2.24	14.10	12.80	13.45	1701.5
	4	2830	5300	1675	1.530	12.55	0.0173	0.0324	0.0380	0.199	2.46	14.10	13.07	13.57	1702.0
	Max	2970	5400	1675	1.605	12.55	0.0182	0.0330	0.0382	0.199	2.46	14.10	13.15	13.70	1722.0
	Min	2710	4760	1660	1.525	11.90	0.0166	0.0295	0.0340	0.189	2.24	14.07	12.80	13.45	1701.0
	Avg	2830	5120	1785	1.553	12.35	0.0174	0.0315	0.0365	0.193	2.39	14.09	13.04	13.61	1705.9
Uphill	1	2595	5080	2075	1.480	12.67	0.0176	0.0342	0.0472	0.240	2.81	14.05	13.35	13.70	1982.5
	2	2525	4860	2040	1.425	11.17	0.0176	0.0334	0.0450	0.222	2.59	14.15	12.46	13.71	1985.5
	3	2065	4695	1655	1.495	11.96	0.0174	0.0329	0.0430	0.215	2.65	14.15	12.80	13.47	1942.5
	4	2315	4855	1990	1.735	12.27	0.0156	0.0333	0.0425	0.206	2.67	14.15	13.00	13.57	1987.5
	Max	2595	5080	2075	1.735	12.67	0.0176	0.0342	0.0472	0.240	2.81	14.15	13.35	13.71	1985.5
	Min	2315	4860	1990	1.423	11.17	0.0156	0.0334	0.0425	0.206	2.59	14.05	12.46	13.47	1982.5
	Avg	2480	4722	1985	1.553	12.06	0.0171	0.0329	0.0441	0.219	2.66	14.12	12.89	13.61	1982.6

TABLE C-22. CLASS IV EXHAUST EMISSIONS: ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1967 Chevrolet Stake
Engine: 396-cu.in., V-8
Date: March 20, 1968

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sampler	HC(IR), ppm C	HC(FIA), ppm C	NO_x, ppm	CO, %	CO_2, %	HC(IR), lb/mi	HC(FIA), lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCFM
1	Proportional	3430	9640	1465	1.315	12.6	0.0036	0.0464	0.0260	0.143	2.14	14.2	13.2	13.70	149
2		3450	9970	1440	1.470	12.4	0.0036	0.0466	0.0258	0.161	2.12	14.1	13.1	13.60	150
3		3540	9660	1310	1.305	12.5	0.0192	0.0488	0.0235	0.145	2.14	14.2	13.1	13.60	150
4		3590	9860	1465	1.350	12.7	0.0189	0.0476	0.0256	0.147	2.12	14.2	13.3	13.75	146
Max		3590	9960	1465	1.470	12.70	0.0192	0.0468	0.0260	0.161	2.14	14.2	13.3	13.70	150.0
Min		3430	9640	1310	1.305	12.40	0.0036	0.0464	0.0235	0.145	2.12	14.1	13.1	13.60	146.0
Avg		3490	9942	1425	1.36	12.55	0.0189	0.0479	0.0252	0.149	2.13	14.2	13.2	13.65	148.8
1	Variable Dilution	252	460	69.4	0.055	0.60	0.0207	0.0496	0.0259	0.122	2.05				
2		246	475	58.0	0.060	0.60	0.0200	0.0512	0.0266	0.130	2.05				
3		248	460	29.4	0.060	0.60	0.0195	0.0468	0.0247	0.130	2.04				
4		264	480	69.4	0.060	0.60	0.0229	0.0515	0.0247	0.130	2.05				
Max		264	480	69.4	0.060	0.60	0.0229	0.0515	0.0269	0.130	2.050				
Min		246	460	58.0	0.055	0.60	0.0195	0.0464	0.0236	0.122	2.040				
Avg		250.5	469	66.5	0.059	0.60	0.0205	0.0496	0.0258	0.129	2.046				

TABLE C-23. CLASS IV EXHAUST EMISSIONS - SLIGHT UPHILL ROAD LOAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1967 Chevrolet Biscayne
Engine: 396-cu in., V-8
Date: March 18, 1968

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sampler	HC(FID), ppm C	HC(FIA), ppm C	NOx, ppm	CO, %	CO2, %	HC(FID), lb/mi	HC(FIA), lb/mi	NOx, lb/mi	CO, lb/mi	CO2, lb/mi	Air/Fuel, CO	Air/Fuel, CO2	Air/Fuel, Avg	Exhaust Flow, SCFM
1	Proportional	4631	8700	1490	1.460	11.80	0.0259	0.0485	0.0276	0.1650	2.10	14.1	12.7	13.40	155.0
2		4090	7490	1462	1.435	10.55	0.0232	0.0425	0.0278	0.1650	1.87	14.2	11.9	13.05	158.0
3		4270	7800	1520	1.495	10.70	0.0242	0.0440	0.0286	0.1715	1.95	14.1	12.1	13.10	157.2
4		3740	7050	1425	1.386	9.75	0.0208	0.0392	0.0268	0.1495	1.75	14.2	11.7	12.95	155.0
Max		4631	8700	1520	1.495	11.80	0.0259	0.0485	0.0286	0.1715	2.10	14.2	12.7	13.40	158.0
Min		3740	7050	1425	1.386	9.75	0.0208	0.0392	0.0268	0.1495	1.75	14.1	11.7	12.95	155.0
Avg		4180	7760	1470	1.423	10.65	0.0235	0.0436	0.0277	0.1606	1.91	14.2	12.1	13.13	156.4
1	Variable Dilution	330	460	81.0	0.080	0.60	0.0261	0.0580	0.0292	0.175	2.07				
2		312	460	81.0	0.065	0.29	0.0279	0.0523	0.0300	0.146	2.09				
3		300	440	69.4	0.065	0.29	0.0252	0.0470	0.0246	0.140	2.10				
4		324	420	69.4	0.060	0.29	0.0274	0.0463	0.0249	0.131	2.06				
Max		330	460	81.0	0.080	0.60	0.0261	0.0523	0.0300	0.175	2.10				
Min		300	420	69.4	0.060	0.29	0.0252	0.0463	0.0246	0.131	2.06				
Avg		316	445	75.2	0.068	0.30	0.0279	0.0484	0.0272	0.148	2.07				

TABLE C-2A. CLASS IV EXHAUST EMISSIONS—UPHILL ROAD CORRELATION OF SERVOPROPORTIONAL WITH CONSTANT VOLUME METHODS

Vehicle: 1967 Chevrolet Stake
Engine: 396-cu.in., V-8
Date: March 19, 1968

Cycle: Experimental Twelve-Mode
Fuel: Indolene

Run No.	Sampler	HCNDIR, ppm C	HCFIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HCNDIR, lb/mi	HCFIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Air/Fuel, CO	Air/Fuel, CO_2	Air/Fuel, Avg	Exhaust Flow, SCFM
1	Proportional	3170	6160	1440	1.565	11.70	0.0224	0.0436	0.0398	0.224	2.07	14.1	13.2	13.65	197
2		2970	5780	1835	1.445	12.20	0.0213	0.0422	0.0449	0.224	2.06	14.1	12.9	13.50	208
3		2750	5500	1720	1.400	11.60	0.0203	0.0401	0.0418	0.246	2.68	14.2	12.6	13.36	203
4		2960	5670	1750	1.470	12.60	0.0212	0.0410	0.0421	0.215	2.90	14.2	13.2	13.70	200
Max		3170	6160	1835	1.565	12.70	0.0224	0.0436	0.0449	0.224	2.90	14.20	13.2	13.70	208
Min		2750	5500	1440	1.400	11.60	0.0203	0.0401	0.0398	0.206	2.68	14.10	12.6	13.30	197
Avg		2960	5770	1710	1.470	12.20	0.0215	0.0419	0.0422	0.225	2.82	14.15	13.0	13.54	203
1	Variable Dilution	312	460	111	0.09	0.80	0.0264	0.0492	0.0410	0.175	2.71				
2		300	420	106	0.08	0.80	0.0256	0.0454	0.0372	0.175	2.74				
3		288	380	104	0.08	0.80	0.0243	0.0410	0.0372	0.174	2.74				
4		290	420	115	0.08	0.80	0.0242	0.0442	0.0411	0.174	2.72				
Max		312	460	115	0.09	0.80	0.0264	0.0492	0.0411	0.175	2.74				
Min		288	380	104	0.08	0.80	0.0242	0.0410	0.0372	0.173	2.71				
Avg		297	420	109	0.08	0.80	0.0252	0.0449	0.0390	0.174	2.73				

TABLE E-25. SUMMARY OF CLASS IV EXHAUST EMISSIONS UNDER 1970 FEDERAL HEAVY DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1967 Chevrolet Stake	Sampler: Continuous System
Engine: 366 CID, V-8	Cycle: Federal
Date: July 22 and 23, 1968	Fuel: Indolene

Run No.	Emissions	Cold Cycle, Avg	Hot Cycle, Avg	Weighted Composite, Avg
1*	HC, ppm	277.49	231.09	247.00
	CO, %	1.61	1.419	1.48
2	HC, ppm	263.93	205.90	225.70
	CO, %	1.66	1.50	1.55
3	HC, ppm	278.11	197.21	225.40
	CO, %	1.69	1.61	1.64
4	HC, ppm	258.48	254.99	256.00
	CO, %	1.52	1.37	1.42

*Most representative four cycle concentration run data presented in Table E-12 of this appendix.

TABLE C-36. CLASS IV EXHAUST EMISSIONS UNDER THE 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

(Representative Mode Data Run 1)

Vehicle: 1967 Chevrolet Stake
Engine: 366 CID, V-8
Date: July 22, 1968

Sampler: Continuous System
Cycle: Federal
Fuel: Indolene

Cycle No. 1

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	60	8.95	9.2	1.060	63.60	9.487	2.29	0.3415
2	155	1.60	14.2	0.965	149.58	1.544	13.31	0.1374
3	110	0.35	14.2	1.008	110.88	0.353	28.50	0.0907
4	130	1.53	14.2	0.970	126.10	1.484	11.22	0.1321
5	105	1.30	14.5	0.959	100.70	1.247	4.73	0.0586
6	120	1.40	14.3	0.972	116.64	1.361	10.38	0.1211
7	145	1.60	14.2	0.967	140.22	1.547	39.68	0.4378
8	130	2.00	14.2	0.954	124.02	1.908	11.04	0.1699
9	5900	4.01	7.01	1.355	7994.50	5.434	167.88	0.1141
Total							289.03	1.603

Cycle No. 2

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	60	8.95	9.2	1.360	63.60	9.487	2.29	0.3415
2	140	1.65	14.2	0.965	135.10	1.592	12.02	0.1417
3	95	0.35	14.2	1.009	95.86	0.353	24.64	0.0907
4	120	1.50	14.5	0.950	114.00	1.425	10.15	0.1268
5	70	1.70	14.8	0.928	64.96	1.578	3.05	0.0742
6	110	1.50	14.5	0.950	104.50	1.425	9.30	0.1268
7	135	1.53	14.5	0.952	128.52	1.457	36.37	0.4123
8	130	1.80	14.5	0.940	122.20	1.692	10.88	0.1506
9	408	4.74	06.4	1.560	7488.00	7.394	157.25	0.1553
Total							265.95	1.620
Average Cold Cycle Concentration							277.49	1.611

Cycle No. 3

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	270	6.75	11.25	0.990	267.30	6.683	9.62	0.2406
2	130	1.75	14.20	0.963	125.19	1.685	11.14	0.1499
3	75	0.45	14.50	0.982	73.65	0.442	18.93	0.1136
4	105	1.55	14.70	0.936	98.28	1.451	8.75	0.1291
5	50	1.00	14.50	0.965	48.25	0.965	2.27	0.0454
6	105	1.55	14.50	0.950	99.75	1.473	8.88	0.1311
7	130	1.33	14.30	0.970	126.10	1.290	35.69	0.3651
8	110	1.80	14.50	0.943	103.73	1.697	9.23	0.1510
9	4200	4.62	7.15	1.417	5951.40	6.547	124.98	0.1375
Total							229.49	1.463

Cycle No. 4

Mode	HC	CO	CO_2	Cor Fac	HC Cor	CO Cor	HC WtD	CO WtD
1	270	6.75	11.25	0.990	267.30	6.682	9.62	0.2406
2	120	1.70	14.30	0.956	114.72	1.625	10.21	0.1446
3	75	0.35	14.50	0.985	73.88	0.345	18.99	0.0867
4	95	1.50	14.50	0.950	90.25	1.425	8.03	0.1268
5	55	0.80	14.80	0.954	52.47	0.763	2.47	0.0359
6	108	1.35	14.50	0.975	105.30	1.316	9.37	0.1171
7	130	1.25	14.80	0.940	122.20	1.175	34.58	0.1325
8	110	1.70	14.50	0.945	103.95	1.607	9.25	0.1430
9	4350	4.19	7.30	1.425	6198.75	5.971	130.17	0.1254
Total							232.69	1.355
Average Hot Cycle Composite Emissions							231.09	1.409

Four Cycle Composite Emissions:
  Hydrocarbons 247 ppm
  Carbon Monoxide 1.48%

TABLE C-27. CLASS IV EXHAUST EMISSION UNDER 1970 FEDERAL HEAVY-DUTY GASOLINE TRUCK PROCEDURE

Vehicle: 1967 Chevrolet Stake
Engine: 366 CID, V-8
Date: July 22-23, 1968

Sampler: Variable Dilution
Cycle: Federal
Fuel: Indolene

Run No.	HC/IR, ppm C	HC/FIA, ppm C	NO_x, ppm	CO, %	CO_2, %	HC/IR, lb/mi	HC/FIA, lb/mi	NO_x, lb/mi	CO, lb/mi	CO_2, lb/mi	Exhaust Flow, SCF/mi
1	310	535	215	0.170	1.6	0.00999	0.0244	0.0329	0.157	2.320	166
2	300	500	148	0.150	1.8	0.01150	0.0223	0.0273	0.135	2.550	171
3	270	465	214	0.155	1.4	0.01030	0.0210	0.0231	0.141	2.010	138
4	260	460	188	0.155	1.5	0.00990	0.0207	0.0278	0.142	2.165	143
Max	310	535	215	0.170	1.8	0.01150	0.0244	0.0329	0.157	2.550	171
Min	260	460	148	0.150	1.4	0.00990	0.0207	0.0231	0.135	2.010	138
Avg	285	490	191	0.158	1.6	0.01042	0.0221	0.0276	0.144	2.261	154

Note: Variable dilution concentration values are not adjusted for diluent air contaminations. Mass emission values as lb/mi are adjusted for influence of background air.

APPENDIX D

GASOLINE POWERED VEHICLE BASELINE EMISSIONS INSPECTION RESULTS

TABLE D-1. CLASS II VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number II-1
Date Inspected September 11, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 88,806
Source/service Ryder Rental / Stake, Rental

GVW, lb 9,800 Tire Size 750 X 16
Engine CID/cylinders 223/I-6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16.0 in. Hg resulting in 5 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 8 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	450	440	60	60
HC, FID, ppm C	820	740	--	--
CO, NDIR, %	0.120	0.120	--	--
CO_2, NDIR, %	0.80	0.80	--	--
NO_x, Saltz, ppm NO_2	73	69	--	--
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0244	0.0236
HC, FID, lb/mile	0.0506	0.0459
CO, NDIR, lb/mile	0.398	0.401
CO_2, NDIR, lb/mile	1.560	1.576
NO_x, Saltz, lb/mile	0.0189	0.0142
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	135	133

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[a] Corrected for background.

TABLE D-2. CLASS II VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number II-2
Date Inspected September 13, 1968

Vehicle Description
Make/year Chevrolet / 1963
Odometer, miles 45,732
Source/service Avis Rental / Stake rental

GVW, lb 10,000 Tire Size 700 X 18
Engine CID/cylinders 230 / I-6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 55.0

Preparation Data
At 30 mph level road, manifold vacuum was 12.5 in. Hg resulting in 3 hp rear wheel power (obs) at 1630 rpm engine speed. Timing was 11 °BTC at 550 rpm idle.
Observed engine condition Poor
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	345	365	45	45
HC, FID, ppm C	555	610	--	--
CO, NDIR, %	0.215	0.215	--	--
CO_2, NDIR, %	0.55	0.55	--	--
NO_x, Saltz, ppm NO_2	115	115	69	69
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0196	0.0209
HC, FID, lb/mile	0.0361	0.0397
CO, NDIR, lb/mile	0.282	0.282
CO_2, NDIR, lb/mile	1.135	1.135
NO_x, Saltz, lb/mile	0.0109	0.0109
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	105	114.5

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[a] Corrected for background.

TABLE D-3. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-3 Date Inspected November 11, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 51
Source/service City Public Service Board / Stake, purchasing dept
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 304 / V-8
Transmission type/speeds International T-15 (Manual)/ 4
Axles, drive/dead 1 / 0 N/V 31.7

Preparation Data
At 30 mph level road, manifold vacuum was 10.5 in. Hg resulting in 6 hp rear wheel power (obs) at 1550 rpm engine speed. Timing was 10B °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 18 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	300	310	30	30
HC, FID, ppm C	990	990	—	—
CO, NDIR, %	0.225	0.24	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	92	92	21	21
NO, NDIR, ppm NO	130	130	60	60

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0301	0.0307
HC, FID, lb/mile	0.0633	0.0630
CO, NDIR, lb/mile	0.302	0.320
CO_2, NDIR, lb/mile	1.680	1.680
NO_x, Saltz, lb/mile	0.0132	0.0126
NO, NDIR, lb/mile	0.0108	0.0107
Exhaust flow, SCF/mile	152	143

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[1] Corrected for background

TABLE D-4. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-4 Date Inspected November 12, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 83,196
Source/service City Public Service Board / Welding and pipe fitting
GVW, lb 9800 Tire Size 750 X 16
Engine CID/cylinders 332 / V-8
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 66.1

Preparation Data
At 30 mph level road, manifold vacuum was 14.4 in. Hg resulting in 3.00 rear wheel power (obs) at 2000 rpm engine speed. Timing was 10 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 32 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	380	320	60	60
HC, FID, ppm C	950	900	—	—
CO, NDIR, %	0.13	0.13	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz, ppm NO_2	185	162	46	46
NO, NDIR, ppm NO	210	180	60	60

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0340	0.0313
HC, FID, lb/mile	0.0624	0.0605
CO, NDIR, lb/mile	0.172	0.177
CO_2, NDIR, lb/mile	1.872	1.930
NO_x, Saltz, lb/mile	0.0301	0.0258
NO, NDIR, lb/mile	0.0220	0.0182
Exhaust flow, SCF/mile	134	133

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[1] Corrected for background

TABLE D-5. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number H 5

Date Inspected November 12, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 601
Source/service City Public Service Board / Stake, purchasing
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 304 / V-8
Transmission type/speeds International T-15 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 33.3

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 9 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was TDC °BTC at 600 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: 40 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	460	480	60	60
HC, FID, ppm C	620	640	—	—
CO, NDIR, %	0.18	0.18	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz, ppm NO_2	92	92	23	23
NO, NDIR, ppm NO	150	140	80	80

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0275	0.0277
HC, FID, lb/mile	0.0554	0.0550
CO, NDIR, lb/mile	0.346	0.336
CO_2, NDIR, lb/mile	1,930	1,860
NO_x, Saltz, lb/mile	0.0136	0.0130
NO, NDIR, lb/mile	0.0115	0.0097
Exhaust flow, SCF/mile	199	190

---

[a] Corrected for background

TABLE D-6. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number H 6

Date Inspected November 11, 1968

Vehicle Description
Make/year Dodge / 1963
Odometer, miles 4951
Source/service City Public Service Board / Welding
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 225 / L6
Transmission type/speeds New Process 420 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 33.3

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 5 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 10 °BTC at 660 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	390	450	30	30
HC, FID, ppm C	670	780	—	—
CO, NDIR, %	0.23	0.22	—	—
CO_2, NDIR, %	0.8	0.7	—	—
NO_x, Saltz, ppm NO_2	92	92	23	23
NO, NDIR, ppm NO	180	180	95	95

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0235	0.0271
HC, FID, lb/mile	0.0433	0.0505
CO, NDIR, lb/mile	0.327	0.287
CO_2, NDIR, lb/mile	1,645	1,439
NO_x, Saltz, lb/mile	0.0153	0.0153
NO, NDIR, lb/mile	0.0129	0.0128
Exhaust flow, SCF/mile	138	118

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[a] Corrected for background

TABLE D-7. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-7 Date Inspected November 13, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 1326
Source/service City Public Service Board / Electrical repair
GVW, lb 8800 Tire Size 750 X 16
Engine CID/cylinders 304 / V-8
Transmission type/speeds International T-15 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 53.3

Preparation Data
At 30 mph level road, manifold vacuum was 10 in. Hg resulting in 7.00 rear wheel power (obs) at 1600 rpm engine speed. Timing was 4 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	530	570	50	50
HC, FID, ppm C	950	990	--	--
CO, NDIR, %	0.20	0.17	--	--
CO_2, NDIR, %	0.8	0.7	--	--
NO_x, Saltz, ppm NO_2	112	114	40	46
NO, NDIR, ppm NO	200	190	93	93

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0326	0.0340
HC, FID, lb/mile	0.0613	0.0624
CO, NDIR, lb/mile	0.362	0.223
CO_2, NDIR, lb/mile	1.724	1.447
NO_x, Saltz, lb/mile	0.0156	0.0156
NO, NDIR, lb/mile	0.0158	0.0143
Exhaust flow, SCF/mile	149	132

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*Corrected for background

TABLE D-8. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-8 Date Inspected November 14, 1968

Vehicle Description
Make/year Ford / 1966
Odometer, miles 29,185
Source/service City Public Service Board / Home gas service
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 240 / I-6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 73.3

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 10.0 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 12 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment 2-3 shift at 14 mph, 3-4 shift at 25 mph to meet first specified time.

Time to reach end of accel shifting modes: 8 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	440	460	30	30
HC, FID, ppm C	800	820	--	--
CO, NDIR, %	0.22	0.20	--	--
CO_2, NDIR, %	0.9	0.9	--	--
NO_x, Saltz, ppm NO_2	112	113	22	21
NO, NDIR, ppm NO	240	220	110	110

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0270	0.0286
HC, FID, lb/mile	0.0523	0.0543
CO, NDIR, lb/mile	0.291	0.269
CO_2, NDIR, lb/mile	1.870	1.900
NO_x, Saltz, lb/mile	0.211	0.0207
NO, NDIR, lb/mile	0.0197	0.0215
Exhaust flow, SCF/mile	132	133

---

*Corrected for background

TABLE D-9. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-9 Date Inspected November 14, 1968

Vehicle Description
Make/year Ford / 1966
Odometer, miles 34,783
Source/service City Public Service Board / Home electrical service
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 240 / I6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 26.7

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 5 hp. rear wheel power (obs) at 1700 rpm engine speed. Timing was 14 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: ______ sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	390	420	50	60
HC, FID, ppm C	680	740	—	—
CO, NDIR, %	0.30	0.31	—	—
CO_2, NDIR, %	1.0	0.9	—	—
NO_x, Saltz, ppm NO_2	69	69	23	23
NO, NDIR, ppm NO	210	200	120	120

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0221	0.0247
HC, FID, lb/mile	0.0435	0.0489
CO, NDIR, lb/mile	0.388	0.414
CO_2, NDIR, lb/mile	2.030	1.890
NO_x, Saltz, lb/mile	0.0127	0.0133
NO, NDIR, lb/mile	0.0140	0.0129
Exhaust flow, SCF/mile	170	146

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[a] Corrected for background.

TABLE D-10. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-10 Date Inspected November 15, 1968

Vehicle Description
Make/year Dodge / 1968
Odometer, miles 852
Source/service City Public Service Board / Electrical supply
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 318 / V 8
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 23.3

Preparation Data
At 30 mph level road, manifold vacuum was 13.5 in. Hg resulting in 7 hp. rear wheel power (obs) at 1600 rpm engine speed. Timing was 4 °BTC at 420 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: ______ sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	370	390	30	30
HC, FID, ppm C	690	720	—	—
CO, NDIR, %	0.29	0.30	—	—
CO_2, NDIR, %	0.9	0.8	—	—
NO_x, Saltz, ppm NO_2	113	113	32	23
NO, NDIR, ppm NO	160	230	60	60

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0232	0.0242
HC, FID, lb/mile	0.0458	0.0479
CO, NDIR, lb/mile	0.396	0.403
CO_2, NDIR, lb/mile	1.932	1.690
NO_x, Saltz, lb/mile	0.0163	0.0208
NO, NDIR, lb/mile	0.0154	0.0157
Exhaust flow, SCF/mile	162	142

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[a] Corrected for background

TABLE D-11. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-11

Date Inspected November 15, 1968

Vehicle Description

Make/year Ford / 1965
Odometer, miles 14,329
Source/service City Public Service Board / Utility delivery

GVW, lb 10,000 Tire Size 750 X 17
Engine CID/cylinders 240 / I6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data

At 30 mph lev l road, manifold vacuum was 14.5 in. Hg resulting in 7.9hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 10 °BTC at 800 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes 10 sec

Emissions Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	620	630	30	30
HC, FID, ppm C	1060	1090	—	—
CO, NDIR, %	0.18	0.20	—	—
CO₂, NDIR, %	0.8	0.8	—	—
NOₓ, Saltz, ppm NO₂	115	119	46	67
NO, NDIR, ppm NO	160	160	60	60

Emissions Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0379	0.0383
HC, FID, lb/mile	0.0703	0.0735
CO, NDIR, lb/mile	0.240	0.671
CO₂, NDIR, lb/mile	1,680	1,290
NOₓ, Saltz, lb/mile	0.0160	0.0163
NO, NDIR, lb/mile	0.0150	0.0151
Exhaust flow, SCF/mile	148	155

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†Corrected for background

TABLE D-12. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-12

Date Inspected November 18, 1968

Vehicle Description

Make/year Dodge / 1968
Odometer, miles 185
Source/service City Public Service Board / Wire truck

GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 318 / V8
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 33.3

Preparation Data

At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 5.5hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 6 °BTC at 600 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 37 sec

Emissions Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	290	300	30	30
HC, FID, ppm C	330	330	—	—
CO, NDIR, %	0.333	0.333	—	—
CO₂, NDIR, %	1.0	1.0	—	—
NOₓ, Saltz, ppm NO₂	69	86	23	23
NO, NDIR, ppm NO	120	120	30	30

Emissions Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0176	0.0184
HC, FID, lb/mile	0.0333	0.0363
CO, NDIR, lb/mile	0.481	0.490
CO₂, NDIR, lb/mile	2,120	2,170
NOₓ, Saltz, lb/mile	0.0107	0.0100
NO, NDIR, lb/mile	0.0134	0.0137
Exhaust flow, SCF/mile	176	176

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†Corrected for background

TABLE D-13. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-13 Date Inspected November 18, 1968

Vehicle Description
Make/year Ford / 1964
Odometer, miles —
Source/service City Public Service Board / Stake, delivery

GVW, lb 10,000 Tire Size 750X 17
Engine CID/cylinders 223 / I-6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 26.7

Preparation Data
At 30 mph level road, manifold vacuum was — in. Hg resulting in — rear wheel power (obs) at — rpm engine speed. Timing was 14 °BTC at — rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: — sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	770	800	30	30
HC, FID, ppm C	1380	1390	—	—
CO, NDIR, %	0.42	0.44	—	—
CO_2, NDIR, %	0.7	0.6	—	—
NO_x, Saltz, ppm NO_2	46	46	11	11
NO, NDIR, ppm NO	80	90	30	30

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0499	0.0519
HC, FID, lb/mile	0.0908	0.0934
CO, NDIR, lb/mile	0.471	0.598
CO_2, NDIR, lb/mile	1,490	1,281
NO_x, Saltz, lb/mile	0.0093	0.0098
NO, NDIR, lb/mile	0.0076	0.0091
Exhaust flow, SCF/mile	150	136

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[1] Corrected for background.

TABLE D-14. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-14 Date Inspected November 19, 1968

Vehicle Description
Make/year Ford / 1966
Odometer, miles 77,770
Source/service City Public Service Board / Electric repair

GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 240 / I-6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 30.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 14 hp rear wheel power (obs) at 1500 rpm engine speed. Timing was 10 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: 37 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	360	400	30	30
HC, FID, ppm C	670	750	—	—
CO, NDIR, %	0.33	0.32	—	—
CO_2, NDIR, %	1.0	1.1	—	—
NO_x, Saltz, ppm NO_2	92	92	11	11
NO, NDIR, ppm NO	160	134	30	30

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0226	0.0246
HC, FID, lb/mile	0.0443	0.0498
CO, NDIR, lb/mile	0.452	0.429
CO_2, NDIR, lb/mile	1,960	2,300
NO_x, Saltz, lb/mile	0.0161	0.0138
NO, NDIR, lb/mile	0.0169	0.132
Exhaust flow, SCF/mile	194	209

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[1] Corrected for background.

TABLE D-15. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-15 Date Inspected November 19, 1968

Vehicle Description
Make/year Ford / 1966
Odometer, miles 77,893
Source/service City Public Service Board / Electrical repair

GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 240 / I-6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 30.0

Preparation Data
At 30 mph level road, manifold vacuum was 16.5 in. Hg resulting in 10 hp rear wheel power (obs) at 1200 rpm engine speed. Timing was 12 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: 38 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	288	310	30	30
HC, FID, ppm C	530	530	—	—
CO, NDIR, %	0.245	0.235	—	—
CO_2, NDIR, %	1.1	1.1	—	—
NO_x, Saltz, ppm NO_2	115	104	11	11
NO, NDIR, ppm NO	189	180	30	30

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0164	0.0173
HC, FID, lb/mile	0.0350	0.0370
CO, NDIR, lb/mile	0.328	0.311
CO_2, NDIR, lb/mile	2.320	2.290
NO_x, Saltz, lb/mile	0.0203	0.0180
NO, NDIR, lb/mile	0.0191	0.0192
Exhaust flow, SCF/mile	203	202

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*Corrected for background

TABLE D-16. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-16 Date Inspected November 20, 1968

Vehicle Description
Make/year Ford / 1961
Odometer, miles 84,333
Source/service City Public Service Board / Electrical repair

GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 223 / I-6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 30.0

Preparation Data
At 30 mph level road, manifold vacuum was 13.0 in. Hg resulting in 5 hp rear wheel power (obs) at 1200 rpm engine speed. Timing was 14 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: 26 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	800	820	30	30
HC, FID, ppm C	1330	1370	—	—
CO, NDIR, %	0.23	0.23	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	69	69	11	11
NO, NDIR, ppm NO	160	70	30	30

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0496	0.0510
HC, FID, lb/mile	0.0954	0.0901
CO, NDIR, lb/mile	0.312	0.319
CO_2, NDIR, lb/mile	1.710	1.675
NO_x, Saltz, lb/mile	0.0107	0.0103
NO, NDIR, lb/mile	0.0130	0.0106
Exhaust flow, SCF/mile	134	139

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*Corrected for background

TABLE II-17. CLASS II VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number II-17 Date Inspected November 20, 1968

Vehicle Description
Make/year Chevrolet / 1959
Odometer, miles 99,367
Source/service City Public Service Board / Electrical repair
GVW, lb 9600 Tire size 700 X 17
Engine CID/cylinders 235 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles: drive/dead 1 / 0 N/V 36.7

Preparation Data
At 30 mph level road, manifold vacuum was 13 in. Hg resulting in 3.70 rear wheel power (obs) at 1700 rpm engine speed. Timing was 5 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 39 sec

Emissions: Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	110	120	31	30
HC, FID, ppm C	370	370	—	—
CO, NDIR, %	0.205	0.18	—	—
CO_2, NDIR, %	0.80	0.80	—	—
NO_x, Saltz, ppm NO_2	69	69	11	11
NO, NDIR, ppm NO	140	140	60	60

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0242	0.0213
HC, FID, lb/mile	0.0388	0.0398
CO, NDIR, lb/mile	0.282	0.243
CO_2, NDIR, lb/mile	1.73	1.72
NO_x, Saltz, lb/mile	0.0108	0.0103
NO, NDIR, lb/mile	0.0135	0.0124
Exhaust flow, SCF/mile	156	161

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[a] Corrected for background

TABLE II-18. CLASS II VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number II-18 Date Inspected November 21, 1968

Vehicle Description
Make/year Ford / 1964
Odometer, miles 77,335
Source/service City Public Service Board / Purchase
GVW, lb 10,000 Tire size 750 X 16
Engine CID/cylinders 321 / L6
Transmission type/speeds Warner T98A (Manual) / 4
Axles: drive/dead 1 / 1 N/V 63.0

Preparation Data
At 30 mph level road, manifold vacuum was 13.5 in. Hg resulting in 3.00 rear wheel power (obs) at 1950 rpm engine speed. Timing was 12 °BTC at 500 rpm idle.
Observed engine condition Poor
Cycle Adjustment 2-3 shift 14 mph, 3-4 shift 23 mph

Time to reach end of accel shifting modes: 43 sec

Emissions: Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	790	800	60	60
HC, FID, ppm C	1330	1350	—	—
CO, NDIR, %	0.30	0.29	—	—
CO_2, NDIR, %	0.8	0.90	—	—
NO_x, Saltz, ppm NO_2	93.4	93.4	—	—
NO, NDIR, ppm NO	170	145	80	80

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0481	0.0483
HC, FID, lb/mile	0.0890	0.0874
CO, NDIR, lb/mile	0.405	0.379
CO_2, NDIR, lb/mile	1.700	1.920
NO_x, Saltz, lb/mile	0.0161	0.0154
NO, NDIR, lb/mile	0.0142	0.0103
Exhaust flow, SCF/mile	169	191

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[a] Corrected for background

TABLE II-19. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-19 Date Inspected November 21, 1968

Vehicle Description
Make/year Chevrolet / 1959
Odometer, miles 7708
Source/service City Public Service Board / Portable welder
GVW, lb 9800 Tire Size 700 X 17
Engine CID/cylinders 235 / I 6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 56.7

Preparation Data
At 30 mph level road, manifold vacuum was 15.0 in. Hg resulting in 5.00 rear wheel power (obs) at 1700 rpm engine speed. Timing was 8 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 38 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	650	640	60	60
HC, FID, ppm C	1120	1100		
CO, NDIR, %	0.15	0.17		
CO_2, NDIR, %	0.9	0.9		
NO_x, Saltz, ppm NO_2	92	69	23	23
NO, NDIR, ppm NO	170	135	80	80

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0208	0.0203
HC, FID, lb/mile	0.0749	0.0740
CO, NDIR, lb/mile	0.202	0.231
CO_2, NDIR, lb/mile	1,910	1,920
NO_x, Saltz, lb/mile	0.0160	0.0108
NO, NDIR, lb/mile	0.0147	0.0133
Exhaust flow, SCF/mile	180	177

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[a] Corrected for background

TABLE II-20. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-20 Date Inspected November 22, 1968

Vehicle Description
Make/year Chevrolet / 1968
Odometer, miles 218
Source/service City Public Service Board / Crew carrier
GVW, lb 7500 Tire Size 750 X 16
Engine CID/cylinders 250 / I 6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data
At 30 mph level road, manifold vacuum was 16.2 in. Hg resulting in 5.00 rear wheel power (obs) at 1400 rpm engine speed. Timing was 8 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 37 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	320	360	30	30
HC, FID, ppm C	570	630		
CO, NDIR, %	0.325	0.32		
CO_2, NDIR, %	0.8	0.7		
NO_x, Saltz, ppm NO_2	46	69	23	23
NO, NDIR, ppm NO	140	140	90	90

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0177	0.0202
HC, FID, lb/mile	0.0369	0.0408
CO, NDIR, lb/mile	0.425	0.418
CO_2, NDIR, lb/mile	1,850	1,430
NO_x, Saltz, lb/mile	0.0054	0.0103
NO, NDIR, lb/mile	0.0080	0.0079
Exhaust flow, SCF/mile	144	125

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[a] Corrected for background

TABLE D-21. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number **II-21** Date Inspected **November 25, 1968**

Vehicle Description
Make/year **Chevrolet / 1969**
Odometer, miles **1394**
Source/service **Avis Rental / Stake, rental**
GVW, lb **10,000** Tire Size **700 X 18**
Engine CID/cylinders **250 / I6**
Transmission type/speeds **Chevrolet (Manual) / 4**
Axles: drive/dead **1 / 0** N/V **51.7**

Preparation Data
At 30 mph level road, manifold vacuum was **16** in. Hg resulting in **3 hp** rear wheel power (obs) at **1350** rpm engine speed. Timing was **8** °BTC at **500** rpm idle.
Observed engine condition **Good**
Cycle Adjustment **None**

Time to reach end of accel shifting modes: **37** sec.

Emissions: Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	295	305	30	30
HC, FID, ppm C	535	580	—	—
CO, NDIR, %	0.20	0.225	—	—
CO_2, NDIR, %	9.7	9.7	—	—
NO_x, Saltz, ppm NO_2	69	69	23	23
NO, NDIR, ppm NO	150	140	80	80

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0178	0.0183
HC, FID, lb/mile	0.0356	0.0767
CO, NDIR, lb/mile	0.268	0.299
CO_2, NDIR, lb/mile	1.480	1.460
NO_x, Saltz, lb/mile	0.0107	0.0106
NO, NDIR, lb/mile	0.0117	0.0096
Exhaust flow, SCF/mile	171	176

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[1] Corrected for background

TABLE D-22. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number **II-22** Date Inspected **November 25, 1968**

Vehicle Description
Make/year **Ford / 1966**
Odometer, miles **21,827**
Source/service **City Public Service Board / Electric repair**
GVW, lb **10,000** Tire Size **750 X 16**
Engine CID/cylinders **240 / I6**
Transmission type/speeds **New Process 435 (Manual) / 4**
Axles: drive/dead **1 / 0** N/V **51.7**

Preparation Data
At 30 mph level road, manifold vacuum was **17** in. Hg resulting in **8 hp** rear wheel power (obs) at **1330** rpm engine speed. Timing was **6** °BTC at **460** rpm idle.
Observed engine condition **Fair**
Cycle Adjustment **None**

Time to reach end of accel shifting modes: **38** sec.

Emissions: Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	300	320	30	30
HC, FID, ppm C	850	970	—	—
CO, NDIR, %	0.21	0.21	—	—
CO_2, NDIR, %	9.9	10.0	—	—
NO_x, Saltz, ppm NO_2	92	115	23	23
NO, NDIR, ppm NO	200	210	95	95

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0309	0.0331
HC, FID, lb/mile	0.0556	0.0632
CO, NDIR, lb/mile	0.278	0.276
CO_2, NDIR, lb/mile	1.870	2.060
NO_x, Saltz, lb/mile	0.0155	0.0203
NO, NDIR, lb/mile	0.0163	0.0176
Exhaust flow, SCF/mile	170	180

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[1] Corrected for background

TABLE II-23. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-23
Date Inspected November 26, 1968

Vehicle Description
Make/year Chevrolet / 1969
Odometer, miles 5064
Source/service City Public Service Board / Gas department
GVW, lb 7500 Tire Size 750 X 16
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 30.0

Preparation Data
At 30 mph level road, manifold vacuum was 11 in. Hg resulting in 8 hp rear wheel power (obs) at 1300 rpm engine speed. Timing was 4 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: 43 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	570	580	20	20
HC, FID, ppm C	950	970	—	—
CO, NDIR, %	0.30	0.29	—	—
CO_2, NDIR, %	0.9	0.8	—	—
NO_x, Saltz, ppm NO_2	70	70	22	22
NO, NDIR, ppm NO	140	140	70	70

Emissions, Mass Basis¹

	Run 1	Run 2
HC, NDIR, lb/mile	0.0358	0.0369
HC, FID, lb/mile	0.0649	0.0670
CO, NDIR, lb/mile	0.414	0.404
CO_2, NDIR, lb/mile	1.950	1.750
NO_x, Saltz, lb/mile	0.0110	0.0111
NO, NDIR, lb/mile	0.0114	0.0114
Exhaust flow, SCF/mile	194	167

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[1] Corrected for background

TABLE II-24. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-24
Date Inspected January 6, 1969

Vehicle Description
Make/year Ford / 1967
Odometer, miles 25,783
Source/service San Antonio Transit Co / Tire repair
GVW, lb 6000 Tire Size 750 X 16
Engine CID/cylinders 240 / L6
Transmission type/speeds Ford (Manual) / 3
Axles, drive/dead 1 / 0 N/V 43.1

Preparation Data
At 30 mph level road, manifold vacuum was 13.3 in. Hg resulting in 5 hp rear wheel power (obs) at 1300 rpm engine speed. Timing was 11 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: 37 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	320	460	20	20
HC, FID, ppm C	910	820	—	—
CO, NDIR, %	0.195	0.24	—	—
CO_2, NDIR, %	0.7	0.7	—	—
NO_x, Saltz, ppm NO_2	46	46	11	11
NO, NDIR, ppm NO	30	30	20	20

Emissions, Mass Basis¹

	Run 1	Run 2
HC, NDIR, lb/mile	0.0351	0.0302
HC, FID, lb/mile	0.0633	0.0560
CO, NDIR, lb/mile	0.273	0.291
CO_2, NDIR, lb/mile	1.540	1.320
NO_x, Saltz, lb/mile	0.0053	0.0056
NO, NDIR, lb/mile	0.0049	0.0043
Exhaust flow, SCF/mile	187	139

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[1] Corrected for background

TABLE D-25. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-25 Date Inspected January 7, 1969

Vehicle Description
Make/year Ford / 1967
Odometer, miles 32,045
Source/service San Antonio Transit Co. / Tire repair

GVW, lb 6000 Tire Size 750 X 16
Engine CID/cylinders 240 / I6
Transmission type/speeds Ford (Manual) / 3
Axles, drive/dead 1 / 0 N/V 47.5

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 3 hp rear wheel power (obs) at 1825 rpm engine speed. Timing was 12 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	475	510	50	50
HC, FID, ppm C	930	870		
CO, NDIR, %	0.26	0.26		
CO_2, NDIR, %	0.6	0.6		
NO_x, Saltz, ppm NO_2	46	46	21	21
NO, NDIR, ppm NO	30	30	25	25

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0293	0.0312
HC, FID, lb/mile	0.0560	0.0521
CO, NDIR, lb/mile	0.359	0.357
CO_2, NDIR, lb/mile	1.300	1.295
NO_x, Saltz, lb/mile	0.0656	0.0656
NO, NDIR, lb/mile	0.0020	0.0040
Exhaust flow, SCF/mile	152	148

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†Corrected for background

TABLE D-26. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-26 Date Inspected January 8, 1969

Vehicle Description
Make/year Ford / 1966
Odometer, miles 17,261
Source/service San Antonio Transit Co. / Welding

GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 240 / I6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 30.0

Preparation Data
At 30 mph level road, manifold vacuum was 12.0 in. Hg resulting in 4 hp rear wheel power (obs) at 1100 rpm engine speed. Timing was 12 °BTC at 340 rpm idle.
Observed engine condition Poor-would not accel under load.
Cycle Adjustment Truck would not meet cycle requirements - Data not completed.

Time to reach end of accel shifting mode: sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C				
HC, FID, ppm C				
CO, NDIR, %				
CO_2, NDIR, %				
NO_x, Saltz, ppm NO_2				
NO, NDIR, ppm NO				

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile		
HC, FID, lb/mile		
CO, NDIR, lb/mile		
CO_2, NDIR, lb/mile		
NO_x, Saltz, lb/mile		
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile		

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†Corrected for background

TABLE D-27. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-27
Date Inspected January 8, 1969

Vehicle Description
Make/year Ford / 1966
Odometer, miles 79,874
Source/service San Antonio Transit Co / City bus maintenance
GVW, lb 7300 Tire Size 750 X 16
Engine CID/cylinders 240 / I 6
Transmission type/speeds Ford (Manual) / 3
Axles, drive/dead 1 / 0 N/V 43.3

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 8.00 rear wheel power (obs) at 1300 rpm engine speed. Timing was 12 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment 8 in. Hg vacuum on Mode 8 accel, 14 sec cruise in Mode 9

Time to reach end of accel shifting modes: 41 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	300	300	50	50
HC, FID, ppm C	530	530	—	—
CO, NDIR, %	0.235	0.20	—	—
CO_2, NDIR, %	0.6	0.6	—	—
NO_x, Saltz, ppm NO_2	92	92	36	36
NO, NDIR, ppm NO	65	60	10	10

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0170	0.0171
HC, FID, lb/mile	0.0356	0.0356
CO, NDIR, lb/mile	0.319	0.272
CO_2, NDIR, lb/mile	1.280	1.280
NO_x, Saltz, lb/mile	0.0110	0.0110
NO, NDIR, lb/mile	0.0083	0.0074
Exhaust flow, SCF/mile	124	126

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*Corrected for background

TABLE D-28. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-28
Date Inspected January 10, 1969

Vehicle Description
Make/year Ford / 1960
Odometer, miles 38,949
Source/service San Antonio Transit Co / Road repair
GVW, lb 7400 Tire Size 650 X 16
Engine CID/cylinders 223 / I 6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 33.0

Preparation Data
At 30 mph level road, manifold vacuum was 14.4 in. Hg resulting in 3.00 rear wheel power (obs) at 1650 rpm engine speed. Timing was 10 °BTC at 650 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 35 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	420	390	10	10
HC, FID, ppm C	730	685	—	—
CO, NDIR, %	0.18	0.18	—	—
CO_2, NDIR, %	1.10	1.10	—	—
NO_x, Saltz, ppm NO_2	92	92	11	11
NO, NDIR, ppm NO	68	70	10	10

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0232	0.0226
HC, FID, lb/mile	0.0480	0.0450
CO, NDIR, lb/mile	0.239	0.239
CO_2, NDIR, lb/mile	2.300	2.300
NO_x, Saltz, lb/mile	0.0138	0.0131
NO, NDIR, lb/mile	0.0080	0.0088
Exhaust flow, SCF/mile	132	126

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*Corrected for background

TABLE II-29. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-29 Date Inspected January 9, 1969

Vehicle Description
Make/year Ford / 1966
Odometer, miles 17,303
Source/service San Antonio Transit Co. / Welding

GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 240 / I6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 31.7

Preparation Data
At 30 mph level road, manifold vacuum was 11.5 in. Hg resulting in 4.0hp rear wheel power (obs) at 1550 rpm engine speed. Timing was 12 °BTC at 540 rpm idle.
Observed engine condition Fair
Cycle Adjustment Change to 2 in. Hg vacuum on accel in Mode 7; 10-sec cruise in Mode 9

Time to reach end of accel shifting modes: 43 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	280	290	25	25
HC, FID, ppm C	570	570		
CO, NDIR, %	0.33	0.32		
CO_2, NDIR, %	1.40	1.50		
NO_x, Saltz, ppm NO_2	46	46		
NO, NDIR, ppm NO	60	65	10	10

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0168	0.0176
HC, FID, lb/mile	0.0371	0.0373
CO, NDIR, lb/mile	0.424	0.426
CO_2, NDIR, lb/mile	2,890	3,170
NO_x, Saltz, lb/mile	0.0101	0.0100
NO, NDIR, lb/mile	0.0073	0.0081
Exhaust flow, SCF/mile	177	183

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[a] Corrected for background

TABLE II-30. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-30 Date Inspected January 13, 1969

Vehicle Description
Make/year Ford / 1960
Odometer, miles 37,909
Source/service San Antonio Transit Co. / Water and tow

GVW, lb 7400 Tire Size 650 X 16
Engine CID/cylinders 223 / I6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 58.3

Preparation Data
At 30 mph level road, manifold vacuum was 14.2 in. Hg resulting in 5.0hp rear wheel power (obs) at 1750 rpm engine speed. Timing was 12 °BTC at 580 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 37 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	340	330	30	30
HC, FID, ppm C	650	610		
CO, NDIR, %	0.23	0.21		
CO_2, NDIR, %	0.8	0.7		
NO_x, Saltz, ppm NO_2	92.4	92.4		
NO, NDIR, ppm NO	50	60	20	20

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0210	0.0203
HC, FID, lb/mile	0.0437	0.0413
CO, NDIR, lb/mile	0.313	0.289
CO_2, NDIR, lb/mile	1,710	1,510
NO_x, Saltz, lb/mile	0.0103	0.0108
NO, NDIR, lb/mile	0.0046	0.0051
Exhaust flow, SCF/mile	158	151

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[a] Corrected for background

TABLE D-31. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-31 Date Inspected September 4, 1968

Vehicle Description
Make/year Chevrolet / 1968
Odometer, miles 6050
Source/service Avis Truck Rental / Multipurpose, make, rental
GVW, lb 10,000 Tire Size 825 X 20
Engine CID/cylinders 250 / 6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 53.4

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg
resulting in 3 hp rear wheel power (obs) at 1600 rpm
engine spd. Timing was 4 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode — sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	320	340	40	40
HC, FID, ppm C	570	610	40	35
CO, NDIR, %	0.175	0.165	—	—
CO_2, NDIR, %	0.65	0.60	—	—
NO_x, Saltz, ppm NO_2	78	94	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0185	0.0193
HC, FID, lb/mile	0.0361	0.0386
CO, NDIR, lb/mile	0.231	0.218
CO_2, NDIR, lb/mile	1.36	1.24
NO_x, Saltz, lb/mile	0.0163	0.0203
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	113.3	108.3

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[a] Corrected for background

CLASS III TRUCKS

10,001 TO 19,500 LB GROSS VEHICLE WEIGHT

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TABLE D-32. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-1
Date Inspected January 8, 1969

Vehicle Description
Make/year Chevrolet / 1965
Odometer, miles
Source/service White's Rental / Van, rental
GVW, lb 19,500 Tire Size 825 x 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead N/V 64.1

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 18 hp rear wheel power (obs) at 1950 rpm engine speed. Timing was 4 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	376	368		
HC, FID, ppm C	440	610		
CO, NDIR, %	0.170	0.168		
CO_2, NDIR, %	0.36	0.33		
NO_x, Saltz, ppm NO_2	58	51		
NO, NDIR, ppm NO				

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0281	0.0276
HC, FID, lb/mile	0.0449	0.0633
CO, NDIR, lb/mile	0.349	0.346
CO_2, NDIR, lb/mile	1.815	1.743
NO_x, Saltz, lb/mile	0.0134	0.0176
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	139	138

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[1] Corrected for background.

TABLE D-33. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-2
Date Inspected April 3, 1968

Vehicle Description
Make/year Ford / 1967
Odometer, miles 7702
Source/service U-Haul / Van, rental
GVW, lb 17,000 Tire Size 800 X 22.5
Engine CID/cylinders 330 / V-8
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 81.7

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 18 hp rear wheel power (obs) at 1850 rpm engine speed. Timing was 12 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	326	316	60	60
HC, FID, ppm C	810	870		
CO, NDIR, %	0.206	0.209		
CO_2, NDIR, %	1.0	0.99		
NO_x, Saltz, ppm NO_2	190	151		
NO, NDIR, ppm NO				

Emissions, Mass Basis[1]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0290	0.0279
HC, FID, lb/mile	0.0500	0.0533
CO, NDIR, lb/mile	0.258	0.258
CO_2, NDIR, lb/mile	1.97	1.93
NO_x, Saltz, lb/mile	0.0391	0.0310
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	96	100

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[1] Corrected for background.

TABLE D-34. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-3 Date Inspected April 4, 1968

Vehicle Description
Make/year Chevrolet / 1966
Odometer, miles 27,280
Source/service Avis Rental / Van, rental

GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 55.8

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 10 hp rear wheel power (obs) at 1675 rpm engine speed. Timing was 10 °BTC at 500 rpm idle.
Observed engine condition —
Cycle Adjustment None

Time to reach end of accel shifting modes — sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	254	236	72	72
HC, FID, ppm C	610	580	—	—
CO, NDIR, %	0.284	0.274	—	—
CO_2, NDIR, %	0.99	0.88	—	—
NO_x, Saltz, ppm NO_2	139	98	—	—
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0172	0.0166
HC, FID, lb/mile	0.0363	0.0336
CO, NDIR, lb/mile	0.340	0.341
CO_2, NDIR, lb/mile	1.760	1.708
NO_x, Saltz, lb/mile	0.0273	0.0200
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	159	141

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†Corrected for background

TABLE D-35. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-4 Date Inspected April 11, 1968

Vehicle Description
Make/year Chevrolet / 1965
Odometer, miles 38,311
Source/service Avis Rental / Van, rental

GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.8

Preparation Data
At 30 mph level road, manifold vacuum was 16.5 in. Hg resulting in 9 hp rear wheel power (obs) at 1825 rpm engine speed. Timing was 8 °BTC at 360 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes — sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	188	242	72	78
HC, FID, ppm C	500	493	—	—
CO, NDIR, %	0.26	0.25	—	—
CO_2, NDIR, %	0.75	0.9	—	—
NO_x, Saltz, ppm NO_2	174.0	174.0	—	—
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0125	0.0167
HC, FID, lb/mile	0.0410	0.0303
CO, NDIR, lb/mile	0.322	0.310
CO_2, NDIR, lb/mile	1.380	1.760
NO_x, Saltz, lb/mile	0.0343	0.0336
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	133	158

---

†Corrected for background

TABLE D-36. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-1 Date Inspected April 29, 1968

Vehicle Description
Make/year Chevrolet / 1968
Odometer, miles 3271
Source/service Avis Rental / Stake, rental

GVW, lb 10,000 Tire Size 700 X 18
Engine CID/cylinders 250 / I-6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 31.7

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 4 hp rear wheel power (obs) at 1550 rpm engine speed. Timing was 4 °BTC at 560 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 33 sec

Emissions, Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	421	371	72	72
HC, FID, ppm C	920	810	—	—
CO, NDIR, %	0.29	0.29	—	—
CO_2, NDIR, %	0.63	0.62	0.045	0.045
NO_x, Saltz, ppm NO_2	38.0	43.9	8.66	8.66
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*	Run 1	Run 2
HC, NDIR, lb/mile	0.0235	0.0159
HC, FID, lb/mile	0.0612	0.0528
CO, NDIR, lb/mile	0.383	0.328
CO_2, NDIR, lb/mile	1.285	1.185
NO_x, Saltz, lb/mile	0.0079	0.0104
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	114	113

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*Corrected for background

TABLE D-37. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-6 Date Inspected April 30, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 19,490
Source/service Avis Rental / Stake, rental hauling

GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 292 / I-6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 36.3

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 2 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 10 °BTC at 720 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes sec

Emissions, Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	314	402	72	72
HC, FID, ppm C	795	660	—	—
CO, NDIR, %	0.30	0.30	—	—
CO_2, NDIR, %	0.76	0.76	—	—
NO_x, Saltz, ppm NO_2	68	69	33	33
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*	Run 1	Run 2
HC, NDIR, lb/mile	0.0202	0.0214
HC, FID, lb/mile	0.0378	0.0428
CO, NDIR, lb/mile	0.383	0.392
CO_2, NDIR, lb/mile	1.460	1.482
NO_x, Saltz, lb/mile	0.0120	0.0122
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	120.3	122

---

*Corrected for background

TABLE D-18. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-7 Date Inspected May 1, 1968

Vehicle Description

Make/year Chevrolet / 1967
Odometer, miles 32,686
Source/service Avis / Service rental

GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 56.7

Preparation Data

At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 8 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 12 °BTC at 650 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	300	300	90	72
HC, FID, ppm C	463	420	--	--
CO, NDIR, %	0.25	0.25	--	--
CO_2, NDIR, %	0.9	0.86	0.045	0.045
NO_x, Saltz, ppm NO_2	113.3	115.3	8.66	17.33
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0184	0.0170
HC, FID, lb/mile	0.0295	0.0327
CO, NDIR, lb/mile	0.321	0.312
CO_2, NDIR, lb/mile	1.735	1.630
NO_x, Saltz, lb/mile	0.0205	0.0152
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	137.2	134.3

---

[a] Corrected for background

TABLE D-19. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-8 Date Inspected May 3, 1968

Vehicle Description

Make/year Ford / 1964
Odometer, miles
Source/service Southwest Research Institute / Delivery and procurement

GVW, lb 14,000 Tire Size 750 X 20
Engine CID/cylinders 223 / L6
Transmission type/speeds Ford (Manual) / 4
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data

At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 4 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 8 °BTC at 450 rpm idle.
Observed engine condition Poor, leaking exhaust system
Cycle Adjustment Shift points for Modes 2 and 3 increased 5 mph to compensate for low engine torque allowing overall shifting time to fall into allocated 1:12

Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	360	384	72	90
HC, FID, ppm C	430	480	--	--
CO, NDIR, %	0.26	0.26	--	--
CO_2, NDIR, %	0.26	0.28	0.040	0.040
NO_x, Saltz, ppm NO_2	38	30	4	3
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0202	0.01935
HC, FID, lb/mile	0.0296	0.0306
CO, NDIR, lb/mile	0.361	0.340
CO_2, NDIR, lb/mile	1.130	1.093
NO_x, Saltz, lb/mile	0.0063	0.0029
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	163	168

---

[a] Corrected for background

TABLE D-40. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-9
Date Inspected May 7, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles
Source/service Ryder R. [illegible] / Stake rental
GVW, lb 16,500 Tire Size 825 X 20
Engine CID/cylinders 262 / I6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 130 rear wheel power (obs) at 1700 rpm engine speed. Timing was 7 °BTC at 540 rpm idle.
Observed engine condition Good
Cycle Adjustment Modes 2 and 3 shifting points were increased 5 mph since small engine had low torque during Mode 3. These changes enabled overall shifting time allocation of 1.12 to be met as required.

Time to reach end of accel shifting mode: ______ sec

Emissions Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	420	420	96	96
HC, FID, ppm C	620	600		
CO, NDIR, %	0.30	0.30		
CO_2, NDIR, %	0.79	0.8		
NO_x, Saltz, ppm NO_2	46	46		
NO, NDIR, ppm NO				

Emissions Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0210	0.0212
HC, FID, lb/mile	0.0323	0.0382
CO, NDIR, lb/mile	0.384	0.386
CO_2, NDIR, lb/mile	1.485	1.530
NO_x, Saltz, lb/mile	0.0037	0.0038
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	126	132

---

[a] Corrected for background

TABLE D-41. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-10
Date Inspected May 10, 1968

Vehicle Description
Make/year Ford / 1962
Odometer, miles 3113
Source/service Ryder / Van rental
GVW, lb 18,000 Tire Size 825 X 20
Engine CID/cylinders 262 / I6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 30.0

Preparation Data
At 30 mph level road, manifold vacuum was 11.5 in. Hg resulting in 130 rear wheel power (obs) at 1200 rpm engine speed. Timing was 8 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment Modes 2 and 3 shifting points were increased 5 mph since small engine had low torque during Mode 4. These changes enabled the driver to meet overall shifting time allocation of 1.12 that must be adhered to.

Time to reach end of accel shifting mode: 36 sec

Emissions Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	375	613	96	96
HC, FID, ppm C	900	930		
CO, NDIR, %	0.29	0.30		
CO_2, NDIR, %	0.57	0.61		
NO_x, Saltz, ppm NO_2	28	42		
NO, NDIR, ppm NO				

Emissions Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0117	0.0171
HC, FID, lb/mile	0.0564	0.0577
CO, NDIR, lb/mile	0.376	0.377
CO_2, NDIR, lb/mile	1.120	1.128
NO_x, Saltz, lb/mile	0.0058	0.0085
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	138	140

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[a] Corrected for background

TABLE D-42. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-11 Date Inspected May 13, 1968

Vehicle Description
Make/year Chevrolet / 1963
Odometer, miles 81,988
Source/service Ryder Rental / Van, rental
GVW, lb 17,000 Tire Size 825 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles: drive/dead 1 / 1 N/V 38.3

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 9 hp rear wheel power (obs) at 1720 rpm engine speed. Timing was 14 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: — sec

Emissions, Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	444	396	96	96
HC, FID, ppm C	660	560	—	—
CO, NDIR, %	0.28	0.27	—	—
CO_2, NDIR, %	9.7	9.7	—	—
NO_x, Saltz, ppm NO_2	63	76	—	8
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0214	0.0184
HC, FID, lb/mile	0.0397	0.0337
CO, NDIR, lb/mile	0.341	0.330
CO_2, NDIR, lb/mile	1,399	1,340
NO_x, Saltz, lb/mile	0.0129	0.0138
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	126	130

---

[a] Corrected for background

TABLE D-43. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-12 Date Inspected August 27, 1968

Vehicle Description
Make/year Ford / 1967
Odometer, miles 14,788
Source/service U-Haul / Van, rental
GVW, lb 12,000 Tire Size 800 X 16.5
Engine CID/cylinders 300 / L6
Transmission type/speeds Ford (Automatic) / 3
Axles: drive/dead 1 / 0 N/V 37.3

Preparation Data
At 30 mph level road, manifold vacuum was 17.5 in. Hg resulting in 5.5 hp rear wheel power (obs) at 1725 rpm engine speed. Timing was 12 °BTC at 700 rpm idle.
Observed engine condition Good
Cycle Adjustment Shifting mode elapsed time of 30 sec met with 3 in. Hg manifold vacuum instead of WOT. The 3 in. setting was the lowest at which automatic trans would shift normally.

Time to reach end of accel shifting mode: 30 sec

Emissions, Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	200	190	40	35
HC, FID, ppm C	366	347	—	—
CO, NDIR, %	0.44	0.33	—	—
CO_2, NDIR, %	8.9	8.9	—	—
NO_x, Saltz, ppm NO_2	92	92	—	—
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.00997	0.00921
HC, FID, lb/mile	0.0319	0.0309
CO, NDIR, lb/mile	0.2760	0.2730
CO_2, NDIR, lb/mile	1,740	1,777
NO_x, Saltz, lb/mile	0.0186	0.0187
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	167	180

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[a] Corrected for background

TABLE D-44. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-13
Date Inspected September 3, 1968

Vehicle Description
Make/year Chevrolet / 1957
Odometer, miles 68,039
Source/service Worcester / Construction, stake

GVW, lb 14,000
Tire Size 800 × 22.5
Engine CID/cylinders 235 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0
N/V 53.3

Preparation Data
At 30 mph level road, manifold vacuum was 18.5 in. Hg resulting in 8 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 8 °BTC at 450 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: ______ sec

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	340	370	10	10
HC, FID, ppm C	630	680		
CO, NDIR, %	0.27	0.285		
CO_2, NDIR, %	0.6	0.6		
NO_x, Saltz, ppm NO_2	69	69		
NO, NDIR, ppm NO				

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0194	0.0217
HC, FID, lb/mile	0.0368	0.0413
CO, NDIR, lb/mile	0.330	0.348
CO_2, NDIR, lb/mile	1.155	1.150
NO_x, Saltz, lb/mile	0.0134	0.0139
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	102	109

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[a] Corrected for background

TABLE D-45. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-14
Date Inspected September 4, 1968

Vehicle Description
Make/year Ford / 1960
Odometer, miles 20,739
Source/service Worcester / Construction, stake

GVW, lb 15,000
Tire Size 750 × 20
Engine CID/cylinders 223 / L6
Transmission type/speeds Ford (Manual) / 4
Axles, drive/dead 1 / 0
N/V 55.0

Preparation Data
At 30 mph level road, manifold vacuum was 13 in. Hg resulting in 8 hp rear wheel power (obs) at 1650 rpm engine speed. Timing was 8 °BTC at 720 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points changed to 16 mph in 2nd and 28 mph in 3rd to obtain 36 sec through shifting mode.

Time to reach end of accel shifting mode: 36 sec

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	430	460	70	70
HC, FID, ppm C	765	780		
CO, NDIR, %	0.25	0.26		
CO_2, NDIR, %	0.8	0.8		
NO_x, Saltz, ppm NO_2	69	69		
NO, NDIR, ppm NO				

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0264	0.0286
HC, FID, lb/mile	0.0463	0.0492
CO, NDIR, lb/mile	0.308	0.331
CO_2, NDIR, lb/mile	1.460	1.600
NO_x, Saltz, lb/mile	0.0140	0.0135
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	121	132

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[a] Corrected for background

TABLE D-46. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-15 Date Inspected September 5, 1968

Vehicle Description

Make/year Ford / 1959
Odometer, miles 31,042
Source/service Southwest Research Institute Dept 11 / Construction
GVW, lb 14,000 Tire Size 800 X 22.5
Engine CID/cylinders 292 / V-8
Transmission type/speeds Ford (Automatic)
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data

At 30 mph level road, manifold vacuum was 17 in. Hg resulting in 8.60 rear wheel power (obs) at 1800 rpm engine speed. Timing was 10 °BTC at 800 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shifting mode time of 30 sec maintained by changing 2-3 shift to 15 mph and 3-4 shift to 27 mph

Time to reach end of accel shifting modes: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	390	350	60	50
HC, FID, ppm C	740	670	—	—
CO, NDIR, %	0.31	0.30	—	—
CO_2, NDIR, %	1.1	1.1	—	—
NO_x, Saltz, ppm NO_2	94	92	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0216	0.0192
HC, FID, lb/mile	0.0464	0.0421
CO, NDIR, lb/mile	0.400	0.383
CO_2, NDIR, lb/mile	2.190	2.200
NO_x, Saltz, lb/mile	0.0148	0.149
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	180	179

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*Corrected for background

TABLE D-47. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-16 Date Inspected September 9, 1968

Vehicle Description

Make/year Ford / 1961
Odometer, miles 74,901
Source/service City of San Antonio / Dump
GVW, lb 16,000 Tire Size 900 X 20
Engine CID/cylinders 292 / V-8
Transmission type/speeds Ford (Manual) / 4
Axles, drive/dead 1 / 0 N/V 46.7

Preparation Data

At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 3.00 rear wheel power (obs) at 1400 rpm engine speed. Timing was 11 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shifting mode time of 30 sec maintained by changing 2-3 shift to 16 mph and 3-4 shift to 27 mph

Time to reach end of accel shifting modes 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	370	400	40	40
HC, FID, ppm C	630	690	—	—
CO, NDIR, %	0.36	0.36	—	—
CO_2, NDIR, %	1.1	1.1	—	—
NO_x, Saltz, ppm NO_2	112	113	45	45
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0198	0.0231
HC, FID, lb/mile	0.0378	0.0439
CO, NDIR, lb/mile	0.432	0.462
CO_2, NDIR, lb/mile	2.180	2.220
NO_x, Saltz, lb/mile	0.0148	0.0137
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	167	170

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*Corrected for background

TABLE D-48. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-17 Date Inspected September 10, 1968

Vehicle Description
Make/year Ford / 1957
Odometer, miles 19,680
Source/service Southwest Research Institute / Dump construction
GVW, lb 1700 Tire Size 900 X 22
Engine CID/cylinders 292 / V-8
Transmission type/speeds Ford (Manual) / 4
Axles: drive/dead 1 / 0 N/V 31.3

Preparation Data
At 30 mph level road, manifold vacuum was 13 in. Hg resulting in 6 hp rear wheel power (obs) at 1330 rpm engine speed. Timing was 11 °BTC at 460 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes sec

Emissions: Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	440	430	60	60
HC, FID, ppm C	780	763	—	—
CO, NDIR, %	0.21	0.21	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	92	92	21	21
NO, NDIR, ppm NO	—	—	—	—

Emissions: Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0251	0.0270
HC, FID, lb/mile	0.0510	0.0504
CO, NDIR, lb/mile	0.278	0.266
CO_2, NDIR, lb/mile	1,665	1,680
NO_x, Saltz, lb/mile	0.0132	0.0136
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	138	131

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†Corrected for background

TABLE D-49. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-18 Date Inspected September 11, 1968

Vehicle Description
Make/year Ford / 1960
Odometer, miles 13,[illegible]
Source/service City of San Antonio / Dump
GVW, lb 16,000 Tire Size 900 X 20
Engine CID/cylinders 292 / V-8
Transmission type/speeds Ford (Manual) / 4
Axles: drive/dead 1 / 0 N/V 33.0

Preparation Data
At 30 mph level road, manifold vacuum was 13 in. Hg resulting in 3 hp rear wheel power (obs) at 1620 rpm engine speed. Timing was 10 °BTC at 380 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points changed to 20 mph in 2nd and 30 mph in 3rd to obtain 36 sec through shifting mode

Time to reach end of accel shifting modes 36 sec

Emissions: Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	400	400	30	30
HC, FID, ppm C	690	760	—	—
CO, NDIR, %	0.30†	0.30†	—	—
CO_2, NDIR, %	1.0	1.0	—	—
NO_x, Saltz, ppm NO_2	138	112	46	46
NO, NDIR, ppm NO	—	—	—	—

Emissions: Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0234	0.0263
HC, FID, lb/mile	0.0456	0.0510
CO, NDIR, lb/mile	0.441	0.432
CO_2, NDIR, lb/mile	2,100	2,100
NO_x, Saltz, lb/mile	0.0231	0.0163
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	172	184

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†Corrected for background

TABLE D-50. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-19 Date Inspected September 16, 1968

Vehicle Description
Make/year Chevrolet / 1956
Odometer, miles 59,000
Source/service City of San Antonio / Tank, fueling

GVW, lb 18,000 Tire Size 900 X 20
Engine CID/cylinders 261 / V 8
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 53.3

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 5 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 8 °BTC at 720 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points changed to 15 mph in 2nd and 25 mph in 3rd to obtain 33 sec through shifting mode

Time to reach end of accel shifting modes 33 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	410	460	60	60
HC, FID, ppm C	680	760		
CO, NDIR, %	0.39	0.38		
CO_2, NDIR, %	0.6	0.6		
NO_x, Saltz, ppm NO_2	48	46		
NO, NDIR, ppm NO				

Emissions, Mass Basis[*]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0231	0.0263
HC, FID, lb/mile	0.0490	0.0500
CO, NDIR, lb/mile	0.5150	0.3110
CO_2, NDIR, lb/mile	1.255	1.255
NO_x, Saltz, lb/mile	0.0101	0.0101
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	101	107

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[*] Corrected for background

TABLE D-51. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-20 Date Inspected September 17, 1968

Vehicle Description
Make/year Chevrolet / 1960
Odometer, miles 80,130
Source/service City of San Antonio / Van, delivery

GVW, lb 19,500 Tire Size 900 X 20
Engine CID/cylinders 235 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 7 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 8 °BTC at 780 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points changed to 15 mph in 2nd and 28 mph in 3rd mode to obtain 34 sec through shifting

Time to reach end of accel shifting modes 34 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	460	435	30	30
HC, FID, ppm C	1060	990		
CO, NDIR, %	0.66	0.64		
CO_2, NDIR, %	1.0	0.9		
NO_x, Saltz, ppm NO_2	46	48		
NO, NDIR, ppm NO				

Emissions, Mass Basis[*]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0272	0.0273
HC, FID, lb/mile	0.0630	0.0672
CO, NDIR, lb/mile	0.840	0.800
CO_2, NDIR, lb/mile	2.10	1.950
NO_x, Saltz, lb/mile	0.0097	0.0108
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile	165	178

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[*] Corrected for background

TABLE D-32. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-21 Date Inspected September 23, 1968

Vehicle Description
Make/year Ford / 1962
Odometer, miles 93,349
Source/service City of San Antonio / Stake, deliver
GVW, lb 18,000 Tire Size 800 X 22.5
Engine CID/cylinders 300 / I-6
Transmission type/speeds Ford (Manual) / 4
Axles: drive/dead 1 / 0 N/V 61.5

Preparation Data
At 30 mph level road, manifold vacuum was 13.0 in. Hg resulting in 3.00 rear wheel power (obs) at 1875 rpm engine speed. Timing was 10 °BTC at 450 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 48 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	420	420	60	70
HC, FID, ppm C	720	720	—	—
CO, NDIR, %	0.23	0.23	—	—
CO_2, NDIR, %	0.6	0.7	—	—
NO_x, Saltz, ppm NO_2	115	113	46	46
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0248	0.0240
HC, FID, lb/mile	0.0490	0.0486
CO, NDIR, lb/mile	0.344	0.341
CO_2, NDIR, lb/mile	1.300	1.490
NO_x, Saltz, lb/mile	0.0162	0.0129
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	111	131

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†Corrected for background

TABLE D-33. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-22 Date Inspected October 3, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 33,118
Source/service City Public Service Board / Stake, gas distribution
GVW, lb 15,200 Tire Size 750 X 20
Engine CID/cylinders 223 / I-6
Transmission type/speeds Warner T98A (Manual) / 4
Axles: drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 3.80 rear wheel power (obs) at 1800 rpm engine speed. Timing was 12 °BTC at 800 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shifting point changed to 16 mph in 2nd, 28 mph in 3rd, and 35 mph in 4th gear to meet specified time.

Time to reach end of accel shifting modes: 38 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	330	380	60	50
HC, FID, ppm C	590	630	—	—
CO, NDIR, %	0.27	0.29	—	—
CO_2, NDIR, %	0.9	0.8	—	—
NO_x, Saltz, ppm NO_2	93	113	36	46
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0178	0.0218
HC, FID, lb/mile	0.0328	0.0423
CO, NDIR, lb/mile	0.333	0.382
CO_2, NDIR, lb/mile	1.850	1.663
NO_x, Saltz, lb/mile	0.0107	0.0138
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	145	140

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†Corrected for background

TABLE D-54. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-23 Date Inspected October 9, 1968

Vehicle Description
Make/year Ford / 1964
Odometer, miles 58,127
Source/service City Public Service Board / Stake, delivery

GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / V-8
Transmission type/speeds Warner T98A (Manual) / 4
Axles: drive/dead 1 / 0 N/V 61.1

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 13 hp rear wheel power (obs) at 1900 rpm engine speed. Timing was 12 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 21 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	450	490	60	60
HC, FID, ppm C	760	640	—	—
CO, NDIR, %	0.17	0.17	—	—
CO_2, NDIR, %	0.10	0.10	—	—
NO_x, Saltz, ppm NO_2	115	113	21	21
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0280	0.0306
HC, FID, lb/mile	0.0538	0.0389
CO, NDIR, lb/mile	0.250	0.241
CO_2, NDIR, lb/mile	1.250	1.230
NO_x, Saltz, lb/mile	0.0222	0.0230
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	167	180

†Corrected for background

TABLE D-55. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-24 Date Inspected October 11, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 15,706
Source/service City Public Service Board / Stake, electrical shop

GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles: drive/dead 1 / 0 N/V 56.7

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 12 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 10 °BTC at 620 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: 20 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	32[illegible]	360	40	40
HC, FID, ppm C	57[illegible]	630	—	—
CO, NDIR, %	0.26	0.27	—	—
CO_2, NDIR, %	0.7	0.7	—	—
NO_x, Saltz, ppm NO_2	83	69	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0208	0.0227
HC, FID, lb/mile	0.0400	0.0444
CO, NDIR, lb/mile	0.368	0.385
CO_2, NDIR, lb/mile	1.559	1.567
NO_x, Saltz, lb/mile	0.0140	0.0108
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	132	133

†Corrected for background

TABLE D-36. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-25 Date Inspected October 16, 1968

Vehicle Description
Make/year Ford / 1966
Odometer, miles 19,482
Source/service City Public Service Board / Stake, delivery
GVW, lb 17,000 Tire Size 750 X 20
Engine CID/cylinders 240 / I6
Transmission type/speeds New Process 435 (Manual) / 4
Axles, drive/dead 1 / 0 N/V 66.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 10 hp rear wheel power (obs) at 1200 rpm engine speed. Timing was 15 °BTC at 370 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: 43 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	440	470	10	10
HC, FID, ppm C	760	820	—	—
CO, NDIR, %	0.24	0.29	—	—
CO_2, NDIR, %	0.8	0.9	—	—
NO_x, Saltz, ppm NO_2	113	113	46	46
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0268	0.0283
HC, FID, lb/mile	0.0516	0.0553
CO, NDIR, lb/mile	0.329	0.342
CO_2, NDIR, lb/mile	1,720	1,680
NO_x, Saltz, lb/mile	0.0162	0.0164
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	178	168

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†Corrected for background

TABLE D-37. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-26 Date Inspected October 17, 1968

Vehicle Description
Make/year Ford / 1966
Odometer, miles 24,472
Source/service City Public Service Board / Cable wire service
GVW, lb 17,000 Tire Size 750 X 20
Engine CID/cylinders 240 / I6
Transmission type/speeds New Process (Manual) / 4
Axles, drive/dead 1 / 0 N/V 66.7

Preparation Data
At 30 mph level road, manifold vacuum was 12.2 in. Hg resulting in 10 hp rear wheel power (obs) at 2000 rpm engine speed. Timing was 15 °BTC at 520 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: 33 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	250	290	30	30
HC, FID, ppm C	430	440	—	—
CO, NDIR, %	0.32	0.29	—	—
CO_2, NDIR, %	1.0	1.0	—	—
NO_x, Saltz, ppm NO_2	113	138	21	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0148	0.0171
HC, FID, lb/mile	0.0286	0.0333
CO, NDIR, lb/mile	0.430	0.382
CO_2, NDIR, lb/mile	2,110	2,060
NO_x, Saltz, lb/mile	0.0208	0.0234
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	170	170

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†Corrected for background

TABLE D-58. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-27 Date Inspected October 21, 1968

Vehicle Description
Make/year Ford / 1964
Odometer, miles 68,739
Source/service City Public Service Board / Stake, line maintenance
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 223 / L6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 9 hp. rear wheel power (obs) at 1700 rpm engine speed. Timing was 12 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment: Shift points: into 3rd, 17 mph; into 4th, 28 mph

Time to reach end of accel shifting mode: 33 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	470	450	60	60
HC, FID, ppm C	800	760	—	—
CO, NDIR, %	0.25	0.26	—	—
CO_2, NDIR, %	0.6	0.7	—	—
NO_x, Saltz, ppm NO_2	92	113	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0283	0.0271
HC, FID, lb/mile	0.0547	0.0533
CO, NDIR, lb/mile	0.345	0.360
CO_2, NDIR, lb/mile	1.302	1.327
NO_x, Saltz, lb/mile	0.0160	0.0214
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	111	122

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†Corrected for background

TABLE D-59. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-28 Date Inspected October 28, 1968

Vehicle Description
Make/year Ford / 1964
Odometer, miles 33,494
Source/service City Public Service Board / Stake, gas distribution
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 223 / L6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data
At 30 mph level road, manifold vacuum was 12.5 in. Hg resulting in 8 hp. rear wheel power (obs) at 1700 rpm engine speed. Timing was 13 °BTC at 470 rpm idle.
Observed engine condition Fair
Cycle Adjustment: Shift points: into 3rd, 13 mph; into 4th, 29 mph

Time to reach end of accel shifting mode: 36 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	440	460	30	30
HC, FID, ppm C	760	800	—	—
CO, NDIR, %	0.235	0.235	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz, ppm NO_2	92	113	23	23
NO, NDIR, ppm NO	180	190	15	15

Emissions, Mass Basis†

	Run 1	Run 2
HC, NDIR, lb/mile	0.0282	0.0293
HC, FID, lb/mile	0.0519	0.0546
CO, NDIR, lb/mile	0.332	0.352
CO_2, NDIR, lb/mile	1.95	1.95
NO_x, Saltz, lb/mile	0.0162	0.0213
NO, NDIR, lb/mile	0.0163	0.0179
Exhaust flow, SCF/mile	162	137

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†Corrected for background

TABLE D-60. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-29 Date Inspected October 28, 1968

Vehicle Description
Make/year Ford / 1962
Odometer, miles 82,728
Source/service City Public Service Board / Line repair (cherry picker)
GVW, lb 17,000 Tire Size 750 X 20
Engine CID/cylinders 223 / L6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 3.50 rear wheel power (rhp) at 1800 rpm engine speed. Timing was 10 °BTC at 520 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points: into 3rd, 17 mph; into 4th, 28 mph

Time to reach end of accel shifting modes 56 sec.

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	450	450	60	60
HC, FID, ppm C	760	780	—	—
CO, NDIR, %	0.34	0.34	—	—
CO_2, NDIR, %	0.9	1.0	—	—
NO_x, Saltz, ppm NO_2	136	162	48	69
NO, NDIR, ppm NO	200	210	65	75

Emissions, Mass Basis*	Run 1	Run 2
HC, NDIR, lb/mile	0.0258	0.0279
HC, FID, lb/mile	0.0319	0.0350
CO, NDIR, lb/mile	0.466	0.494
CO_2, NDIR, lb/mile	1,940	2,240
NO_x, Saltz, lb/mile	0.0216	0.0232
NO, NDIR, lb/mile	0.0206	0.0230
Exhaust flow, SCF/mile	128	180

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*Corrected for background

TABLE D-61. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-30 Date Inspected October 29, 1968

Vehicle Description
Make/year Ford / 1964
Odometer, miles 11,681
Source/service City Public Service Board / Van, personnel transport
GVW, lb 17,000 Tire Size 750 X 20
Engine CID/cylinders 223 / L6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 66.7

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 5.00 rear wheel power (rhp) at 2000 rpm engine speed. Timing was 12 °BTC at 580 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes 30 sec.

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	360	370	30	30
HC, FID, ppm C	625	640	—	—
CO, NDIR, %	0.30	0.28	—	—
CO_2, NDIR, %	1.0	1.0	—	—
NO_x, Saltz, ppm NO_2	118	138	36	46
NO, NDIR, ppm NO	240	210	90	80

Emissions, Mass Basis*	Run 1	Run 2
HC, NDIR, lb/mile	0.0211	0.0213
HC, FID, lb/mile	0.0420	0.0421
CO, NDIR, lb/mile	0.408	0.372
CO_2, NDIR, lb/mile	2,140	2,090
NO_x, Saltz, lb/mile	0.0218	0.0211
NO, NDIR, lb/mile	0.0233	0.0196
Exhaust flow, SCF/mile	131	150

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*Corrected for background

TABLE D-62. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-11 Date Inspected October 29, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 6903
Source/service City Public Service Board / Stake, personnel transport
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 9 hp. rear wheel power (obs) at 1800 rpm engine speed. Timing was 10 °BTC at 400 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	380	330	50	50
HC, FID, ppm C	660	570	—	—
CO, NDIR, %	0.31	0.32	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz, ppm NO_2	113	113	23	23
NO, NDIR, ppm NO	210	220	90	90

Emissions, Mass Basis[*]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0222	0.0191
HC, FID, lb/mile	0.0439	0.0383
CO, NDIR, lb/mile	0.416	0.433
CO_2, NDIR, lb/mile	1,900	1,920
NO_x, Saltz, lb/mile	0.0204	0.0206
NO, NDIR, lb/mile	0.0184	0.0203
Exhaust flow, SCF/mile	137	137

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[*] Corrected for background

TABLE D-63. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-12 Date Inspected October 30, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 34,301
Source/service City Public Service Board / Line maintenance (cherry picker)
GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 262 / L6
Transmission type/speeds Warner T98A (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 5 hp. rear wheel power (obs) at 1800 rpm engine speed. Timing was 14 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points: 14 mph into 3rd, 25 mph into 4th

Time to reach end of accel shifting modes: 31 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	300	330	50	50
HC, FID, ppm C	880	890	—	—
CO, NDIR, %	0.33	0.32	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz, ppm NO_2	178	162	36	69
NO, NDIR, ppm NO	230	300	110	110

Emissions, Mass Basis[*]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0312	0.0321
HC, FID, lb/mile	0.0583	0.0601
CO, NDIR, lb/mile	0.434	0.422
CO_2, NDIR, lb/mile	1,960	1,930
NO_x, Saltz, lb/mile	0.0222	0.0220
NO, NDIR, lb/mile	0.0193	0.0142
Exhaust flow, SCF/mile	177	171

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[*] Corrected for background

TABLE D-64. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-31
Date inspected October 10, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 3367
Source/service City Public Service Board / Stake, gas delivery
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 12.90 rear wheel power (obs) at 1800 rpm engine speed. Timing was 12 °BTC at 420 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes 11 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	470	480	30	40
HC, FID, ppm C	820	830	—	—
CO, NDIR, %	0.28	0.30	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	92	92	—	—
NO, NDIR, ppm NO	220	240	130	120

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0302	0.0307
HC, FID, lb/mile	0.0560	0.0564
CO, NDIR, lb/mile	0.387	0.412
CO_2, NDIR, lb/mile	1.730	1.720
NO_x, Saltz, lb/mile	0.0210	0.0209
NO, NDIR, lb/mile	0.0149	0.0190
Exhaust flow, SCF/mile	121	130

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*Corrected for background

TABLE D-65. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-33
Date inspected November 1, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 3872
Source/service City Public Service Board / Van, gas lines
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (manual) / 4
Axles, drive/dead 1 / 0 N/V 43.3

Preparation Data
At 30 mph level road, manifold vacuum was 12.5 in. Hg resulting in 3.90 rear wheel power (obs) at 1300 rpm engine speed. Timing was 14 °BTC at 400 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 47 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	480	420	20	20
HC, FID, ppm C	800	760	—	—
CO, NDIR, %	0.36	0.34	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz, ppm NO_2	115	92	—	—
NO, NDIR, ppm NO	260	300	120	130

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0281	0.0262
HC, FID, lb/mile	0.0532	0.0516
CO, NDIR, lb/mile	0.484	0.467
CO_2, NDIR, lb/mile	1.900	1.942
NO_x, Saltz, lb/mile	0.0163	0.0161
NO, NDIR, lb/mile	0.0218	0.0135
Exhaust flow, SCF/mile	174	178

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*Corrected for background

TABLE D-66. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-35 Date Inspected November 1, 1968

Vehicle Description
Make/year IHC / 1959
Odometer, miles 55,376
Source/service City Public Service Board / Dump truck, construction
GVW, lb 19,500 Tire Size 900 X 20
Engine CID/cylinders [illegible] / L6
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 F/V 58.7

Preparation Data
At 30 mph level road, manifold vacuum was 14.4 in. Hg resulting in 6 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 10 °BTC at 400 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points: 9 mph into 3rd, 15 mph into 4th, 25 mph into 5th, extra shift due to 5-speed transmission

Time to reach end of accel shifting modes 55 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	420	430	60	60
HC, FID, ppm C	740	780	—	—
CO, NDIR, %	0.22[a]	0.22[a]	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz. ppm NO_2	115	115	40	21
NO, NDIR, ppm NO	230	230	110	110

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0240	0.0260
HC, FID, lb/mile	0.0500	0.0526
CO, NDIR, lb/mile	0.308	0.314
CO_2, NDIR, lb/mile	1.940	2.190
NO_x, Saltz. lb/mile	0.0165	0.0217
NO, NDIR, lb/mile	0.0191	0.0181
Exhaust flow, SCF/mile	171	196

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[a] Corrected for background

TABLE D-67. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-36 Date Inspected November 14, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 10,172
Source/service City Public Service Board / Gas truck
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.0 in. Hg resulting in 3 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 10 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes 40 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	300	330	30	30
HC, FID, ppm C	510	590	—	—
CO, NDIR, %	0.34	0.35	—	—
CO_2, NDIR, %	0.6	0.7	—	—
NO_x, Saltz. ppm NO_2	115	138	46	46
NO, NDIR, ppm NO	210	180	80	80

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0188	0.0206
HC, FID, lb/mile	0.0330	0.0403
CO, NDIR, lb/mile	0.478	0.490
CO_2, NDIR, lb/mile	1.310	1.520
NO_x, Saltz. lb/mile	0.0164	0.0218
NO, NDIR, lb/mile	0.0201	0.0156
Exhaust flow, SCF/mile	107	130

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[a] Corrected for background

TABLE D-68. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-37 Date Inspected November 4, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 10,133
Source/service City Public Service Board / Van, meter repair
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 15 in Hg resulting in 3.00 rear wheel power (obs) at 1,400 rpm engine speed. Timing was 12 °BTC at 520 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes 80 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	665	545	40	40
HC, FID, ppm C	1190	940	--	--
CO, NDIR, %	0.44	0.44	--	--
CO_2, NDIR, %	0.7	0.7	--	--
NO_x, Saltz, ppm NO_2	69	69	--	--
NO, NDIR, ppm NO	170	170	70	70

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0439	0.0338
HC, FID, lb/mile	0.0799	0.0625
CO, NDIR, lb/mile	0.623	0.598
CO_2, NDIR, lb/mile	1.360	1.479
NO_x, Saltz, lb/mile	0.0161	0.0153
NO, NDIR, lb/mile	0.0126	0.0133
Exhaust flow, SCF/mile	167	180

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*Corrected for background

TABLE D-69. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-38 Date Inspected November 6, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 9363
Source/service City Public Service Board / Gas truck, van
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds New Process (Manual) / 4
Axles, drive/dead 1 / 0 N/V 45.0

Preparation Data
At 30 mph level road, manifold vacuum was 14 in Hg resulting in 5 hp rear wheel power (obs) at 1350 rpm engine speed. Timing was 15 °BTC at 400 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes 53 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	180	180	50	50
HC, FID, ppm C	610	580	--	--
CO, NDIR, %	0.30	0.30	--	--
CO_2, NDIR, %	0.7	0.7	--	--
NO_x, Saltz, ppm NO_2	92	92	23	23
NO, NDIR, ppm NO	180	190	70	70

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0203	0.0226
HC, FID, lb/mile	0.0408	0.0462
CO, NDIR, lb/mile	0.405	0.412
CO_2, NDIR, lb/mile	1.487	1.511
NO_x, Saltz, lb/mile	0.0137	0.0160
NO, NDIR, lb/mile	0.0176	0.0183
Exhaust flow, SCF/mile	123	122

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*Corrected for background

TABLE D-70. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-39 Date Inspected November 6, 1968

Vehicle Description
Make/year IHC / 1959
Odometer, miles 30,110
Source/service City Public Service Board / Tractor
GVW, lb 16,500 Tire Size 900 X 20
Engine CID/cylinders 282 / 6
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 18.00 rear wheel power (obs) at 1700 rpm engine speed. Timing was 18 °BTC at 400 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift pnts.: 10 mph into 3rd, 19 mph into 4th; 31 mph into 5th, extra shift due to 5-speed transmission

Time to reach end of accel shifting modes 52 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	415	360	50	63
HC, FID, ppm C	740	630	--	--
CO, NDIR, %	0.25	0.23	--	--
CO_2, NDIR, %	0.9	0.8	--	--
NO_x, Saltz, ppm NO_2	115	112	23	23
NO, NDIR, ppm NO	206	200	63	63

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0252	0.0211
HC, FID, lb/mile	0.0503	0.0437
CO, NDIR, lb/mile	0.472	0.312
CO_2, NDIR, lb/mile	1.920	1.708
NO_x, Saltz, lb/mile	0.0214	0.0210
NO, NDIR, lb/mile	0.0209	0.0206
Exhaust flow, SCF/mile	160	145

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*Corrected for background

TABLE D-71. CLASS III VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number III-40 Date Inspected November 1, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 41
Source/service City Public Service Board / Stake (used in purchasing)
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 304 / V-8
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 33.3

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 5.00 rear wheel power (obs) at 1600 rpm engine speed. Timing was 10K °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 20 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	340	400	50	50
HC, FID, ppm C	610	740	--	--
CO, NDIR, %	0.30	0.29	--	--
CO_2, NDIR, %	0.3	0.3	--	--
NO_x, Saltz, ppm NO_2	33	33	--	--
NO, NDIR, ppm NO	170	175	110	110

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0210	0.0245
HC, FID, lb/mile	0.0428	0.0502
CO, NDIR, lb/mile	0.412	0.413
CO_2, NDIR, lb/mile	1.150	1.150
NO_x, Saltz, lb/mile	0.0034	0.0034
NO, NDIR, lb/mile	0.0100	0.0116
Exhaust flow, SCF/mile	100	98.3

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*Corrected for background

TABLE D-72. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-41 Date Inspected November 5, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 76
Source/service City Public Service Board / Make listed (in purchasing)
GVW, lb 10,000 Tire Size 750 X 16
Engine CID/cylinders 304 / V8
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 35.0

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 7 hp rear wheel power (obs) at 1650 rpm engine speed. Timing was 10 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment Shifting modes changed during accel for short (traffic) condition: into 3rd gear at 16 mph; into 4th gear at 26 mph.
Time to reach end of accel shifting modes 33 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	490	500	60	58
HC, FID, ppm C	870	900	—	—
CO, NDIR, %	0.39	0.44	—	—
CO_2, NDIR, %	9.6	9.6	—	—
NO_x, Saltz, ppm NO_2	32	33	—	—
NO, NDIR, ppm NO	170	180	110	100

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0302	0.0318
HC, FID, lb/mile	0.0605	0.0644
CO, NDIR, lb/mile	0.546	0.636
CO_2, NDIR, lb/mile	1.323	1.363
NO_x, Saltz, lb/mile	0.0054	0.0055
NO, NDIR, lb/mile	0.0102	0.0120
Exhaust flow, SCF/mile	126	107

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*Corrected for background

TABLE D-73. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-42 Date Inspected November 7, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 6,337
Source/service City Public Service Board / Winch (used for transformers)
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds New Process (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 7 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 15 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None
Time to reach end of accel shifting modes 47 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	300	290	60	60
HC, FID, ppm C	500	460	—	—
CO, NDIR, %	0.25	0.25	—	—
CO_2, NDIR, %	9.8	9.8	—	—
NO_x, Saltz, ppm NO_2	128	97	46	23
NO, NDIR, ppm NO	190	180	70	70

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0165	0.0158
HC, FID, lb/mile	0.0328	0.0282
CO, NDIR, lb/mile	0.241	0.243
CO_2, NDIR, lb/mile	1.717	1.295
NO_x, Saltz, lb/mile	0.0215	0.0136
NO, NDIR, lb/mile	0.0183	0.0167
Exhaust flow, SCF/mile	136	105

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*Corrected for background

TABLE D-74. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-41 Date Inspected November 7, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 16,439
Source/service City Public Service Board / Gas
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 7 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 14 °BTC at 550 rpm idle.
Observed engine condition Poor
Cycle Adjustment None

Time to reach end of accel shifting modes: 35 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	880	800	30	30
HC, FID, ppm C	1860	1710	--	--
CO, NDIR, %	0.33	0.35	--	--
CO_2, NDIR, %	0.6	0.7	--	--
NO_x, Saltz. ppm NO_2	31	31	--	--
NO, NDIR, ppm NO	110	110	70	70

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0560	0.0516
HC, FID, lb/mile	0.1281	0.1168
CO, NDIR, lb/mile	0.720	0.632
CO_2, NDIR, lb/mile	1.067	1.319
NO_x, Saltz. lb/mile	0.0035	0.0032
NO, NDIR, lb/mile	0.0064	0.0068
Exhaust flow, SCF/mile	121	129

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[a] Corrected for background

TABLE D-75. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-44 Date Inspected November 8, 1968

Vehicle Description
Make/year Chevrolet / 1968
Odometer, miles 8438
Source/service City Public Service Board / Stake (electric dept)
GVW, lb 16,000 Tire Size 750 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axle: drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16.0 in. Hg resulting in 7 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 4 °BTC at 650 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 34 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	240	240	50	50
HC, FID, ppm C	420	420	--	--
CO, NDIR, %	0.19	0.18	--	--
CO_2, NDIR, %	0.8	0.7	--	--
NO_x, Saltz. ppm NO_2	115	92	46	46
NO, NDIR, ppm NO	120	130	20	30

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0138	0.0131
HC, FID, lb/mile	0.0299	0.0284
CO, NDIR, lb/mile	0.361	0.319
CO_2, NDIR, lb/mile	1.809	1.934
NO_x, Saltz. lb/mile	0.0171	0.0112
NO, NDIR, lb/mile	0.0113	0.0124
Exhaust flow, SCF/mile	127	133

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[a] Corrected for background

TABLE D-78. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-47 Date Inspected November 27, 1968

Vehicle Description

Make/year Dodge / 1969

Odometer, miles 30

Source/service City Public Service Board / Stake, Purchasing

GVW, lb 16,000 Tire Size 750 X 20

Engine CID/cylinders 318 / V-8

Transmission type/speeds New Process 435 (Manual) / 4

Axles, drive/dead 1 / 0 N/V 63.0

Preparation Data

At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 10.00 rear wheel power (obs) at 1950 rpm engine speed. Timing was 5 °BTC at 700 rpm idle.

Observed engine condition Good

Cycle Adjustment None

Time to reach end of accel shifting modes 11 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	400	600	50	50
HC, FID, ppm C	1000	1010	—	—
CO, NDIR, %	0.27	0.21	—	—
CO_2, NDIR, %	1.10	1.10	—	—
NO_x, Saltz. ppm NO_2	69	91	22	22
NO, NDIR, ppm NO	170	150	30	30

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0352	0.151
HC, FID, lb/mile	0.0640	0.0140
CO, NDIR, lb/mile	0.331	0.396
CO_2, NDIR, lb/mile	2.230	2.210
NO_x, Saltz. lb/mile	0.0196	0.0153
NO, NDIR, lb/mile	0.0178	0.0148
Exhaust flow, SCF/mile	373	379

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*Corrected for background

CLASS IV TRUCKS

19,501-LB AND ABOVE
GROSS VEHICLE WEIGHT

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TABLE D-79. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-1 Date Inspected January 17, 1969

Vehicle Description
Make/year GMC / 1966
Odometer, miles 14,300
Source/service Hertz Truck Rental / Stake, rental

GVW, lb 24,000 Tire Size 900 X 20
Engine CID/cylinders 348 / V-8
Transmission type/speeds GMC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 56.2

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 18.0 rear wheel power (obs) at 2330 rpm engine speed. Timing was 11 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 58 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	224	238	--	--
HC, FID, ppm C	495	512	--	--
CO, NDIR, %	0.71	0.71	--	--
CO_2, NDIR, %	0.60	0.57	--	--
NO_x, Saltz, ppm NO_2	39	40		
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0247	0.0252
HC, FID, lb/mile	0.0522	0.0479
CO, NDIR, lb/mile	0.406	0.456
CO_2, NDIR, lb/mile	2.095	2.035
NO_x, Saltz, lb/mile	0.0161	0.0163
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/min	--	--

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*Corrected for background

TABLE D-80. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-2 Date Inspected April 10, 1968

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 4773
Source/service General Motors Research / Test vehicle

GVW, lb 30,000 Tire Size 900 X 20
Engine CID/cylinders 366 / V-8
Transmission type/speeds Clark Equip. Co. (Manual) / 5
Axles, drive/dead 1 / 0 N/V 81.6

Preparation Data
At 30 mph level road, manifold vacuum was 16.0 in. Hg resulting in 12.0 rear wheel power (obs) at 1850 rpm engine speed. Timing was 8 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	240	252	84	84
HC, FID, ppm C	363	360	--	--
CO, NDIR, %	0.062	0.060	--	--
CO_2, NDIR, %	0.68	0.638	--	--
NO_x, Saltz, ppm NO_2	69	65	4	7
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0171	0.0183
HC, FID, lb/mile	0.0493	0.0380
CO, NDIR, lb/mile	0.134	0.128
CO_2, NDIR, lb/mile	2.22	2.13
NO_x, Saltz, lb/mile	0.0231	0.023
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	171	164

---

*Corrected for background

TABLE D-81. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-3 Date Inspected April 2, 1968

Vehicle Description
Make/year IHC / 1966
Odometer, miles 19,135
Source/service Hertz Truck Rental / Stake bdy. rental
GVW, lb 24,000 Tire Size 900 X 20
Engine CID/cylinders 345 / V-8
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 81.7

Preparation Data
At 30 mph level road, manifold vacuum was 11.3 in. Hg resulting in 18 hp rear wheel power (obs) at 1530 rpm engine speed. Timing was 11 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 28 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	324	324	--	--
HC, FID, ppm C	380	380	--	--
CO, NDIR, %	0.143	0.135	--	--
CO_2, NDIR, %	0.60	0.60	--	--
NO_x, Saltz, ppm NO_2	69	69	--	--
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0354	0.0354
HC, FID, lb/mile	0.0415	0.0415
CO, NDIR, lb/mile	0.320	0.340
CO_2, NDIR, lb/mile	2.075	2.08
NO_x, Saltz, lb/mile	0.0253	0.0253
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	152	155

*Corrected for background

TABLE D-82. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-4 Date Inspected May 2, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 4561
Source/service Ryder Truck Rental / Van. rental
GVW, lb 24,000 Tire Size 825 X 20
Engine CID/cylinders 330 / V-8
Transmission type/speeds Clark Equip. Co. (Manual) / 5
Axles, drive/dead 1 / 0 N/V 56.6

Preparation Data
At 30 mph level road, manifold vacuum was 16.0 in. Hg resulting in 9 hp rear wheel power (obs) at 1950 rpm engine speed. Timing was 10 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes -- sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	888	990	102	102
HC, FID, ppm C	1330	1210	--	--
CO, NDIR, %	0.137	0.161	--	--
CO_2, NDIR, %	0.79	0.78	--	--
NO_x, Saltz, ppm NO_2	69	64	7	7
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0546	0.0619
HC, FID, lb/mile	0.0920	0.1042
CO, NDIR, lb/mile	0.191	0.225
CO_2, NDIR, lb/mile	1.37	1.49
NO_x, Saltz, lb/mile	0.0143	0.0134
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	147	135

*Corrected for background

TABLE D-83. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-5 Date Inspected April 8, 1968

Vehicle Description
Make/year Ford / 1967
Odometer, miles 44,316
Source/service Ryder Truck Rental / Truck tractor, rental
GVW, lb 26,000 Tire Size 10.00 X 20
Engine CID/cylinders 477 / V-8
Transmission type/speeds Spicer Div Dana Corp (Manual) / 5
Axles, drive/dead 1 / 0 N/V 30.2

Preparation Data
At 30 mph level road, manifold vacuum was 17.0 in Hg resulting in 10.80 rear wheel power (obs) at 1700 rpm engine speed. Timing was 11 °BTC at 450 rpm idle.
Observed engine condition Very good
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	636	678	96	75
HC, FID, ppm C	870	830	--	--
CO, NDIR, %	0.247	0.224	--	--
CO_2, NDIR, %	0.59	0.62	0.02	0.03
NO_x, Saltz, ppm NO_2	39.4	39.4	4.43	2.86
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*	Run 1	Run 2
HC, NDIR, lb/mile	0.0383	0.0417
HC, FID, lb/mile	0.0605	0.0586
CO, NDIR, lb/mile	0.348	0.329
CO_2, NDIR, lb/mile	1.210	1.330
NO_x, Saltz, lb/mile	0.00816	0.00838
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	188	180

---

*Corrected for background

TABLE D-84. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-6 Date Inspected April 9, 1968

Vehicle Description
Make/year Ford / 1967
Odometer, miles 26,000
Source/service Ryder Truck Rental / Truck tractor, rental
GVW, lb 26,000 Tire Size 10.00 X 20
Engine CID/cylinders 477 / V-8
Transmission type/speeds Spicer Div Dana Corp (Manual) / 5
Axles, drive/dead 1 / 0 N/V 30.2

Preparation Data
At 30 mph level road, manifold vacuum was 17.5 in Hg resulting in 10.50 rear wheel power (obs) at 1700 rpm engine speed. Timing was 10 °BTC at 465 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	672	683	96	90
HC, FID, ppm C	900	920	--	--
CO, NDIR, %	0.30	0.296	--	--
CO_2, NDIR, %	0.66	0.62	--	--
NO_x, Saltz, ppm NO_2	23	23	--	--
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*	Run 1	Run 2
HC, NDIR, lb/mile	0.0413	0.0430
HC, FID, lb/mile	0.0634	0.0653
CO, NDIR, lb/mile	0.428	0.476
CO_2, NDIR, lb/mile	1.62	1.28
NO_x, Saltz, lb/mile	0.0052	0.0052
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	172	199

---

*Corrected for background

TABLE D-85. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-7 Date Inspected May 13, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 78,904
Source/service Ryder Truck Rental / Moving van, rental
GVW, lb 22,000 Tire Size 900 X 20
Engine CID/cylinders 302 / V-8
Transmission type/speeds Clark Equipment Co. (Manual)/5
Axles, drive/dead 1 / 0 N/V 50.3

Preparation Data
At 30 mph level road, manifold vacuum was 17.0 in. Hg resulting in 10 hp rear wheel power (obs) at 2150 rpm engine speed. Timing was 10 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment None
Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	960	872	96	96
HC, FID, ppm C	860	900	--	--
CO, NDIR, %	0.228	0.224	--	--
CO_2, NDIR, %	0.58	0.59		
NO_x, Saltz, ppm NO_2	35	42	3	3
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0383	0.0387
HC, FID, lb/mile	0.0378	0.0600
CO, NDIR, lb/mile	0.308	0.301
CO_2, NDIR, lb/mile	1.25	1.15
NO_x, Saltz, lb/mile	0.00653	0.00860
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	121	106

---

[a] Corrected for background.

TABLE D-86. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-8 Date Inspected May 14, 1968

Vehicle Description
Make/year Ford / 1968
Odometer, miles 315
Source/service Ryder Truck Rental / Stake side, rental
GVW, lb 24,000 Tire Size 900 X 20
Engine CID/cylinders 330 / V-8
Transmission type/speeds Clark Equip Co (Manual) / 5
Axles, drive/dead 1 / 0 N/V 58.3

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 10 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 19 °BTC at 460 rpm idle.
Observed engine condition Good
Cycle Adjustment None
Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	877	865	90	90
HC, FID, ppm C	1300	1240	--	--
CO, NDIR, %	0.176	0.173	--	--
CO_2, NDIR, %	0.84	0.94		
NO_x, Saltz, ppm NO_2	85	83	6	7
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0537	0.0527
HC, FID, lb/mile	0.0808	0.0834
CO, NDIR, lb/mile	0.239	0.234
CO_2, NDIR, lb/mile	1.73	1.72
NO_x, Saltz, lb/mile	0.00193	0.00184
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	136	131

---

[a] Corrected for background.

TABLE D-87. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-9 Date Inspected May 20, 1969

Vehicle Description
Make/year Dodge / 1963
Odometer, miles 165,360
Source/service City of San Antonio / Water tank truck

GVW, lb 23,000 Tire Size 900 X 20
Engine CID/cylinders 318 / V-8
Transmission type/speeds New Process Gear Div (Manual)/5
Axles, drive/dead 1 / 0 N/V 62.8

Preparation Data
At 30 mph level road, manifold vacuum was 16.5 in Hg resulting in 9 hp, rear wheel power (obs) at 1800 rpm engine speed. Timing was 18 °BTC at 550 rpm idle.
Observed engine condition Poor - needed tune up
Cycle Adjustment None

Time to reach end of accel shifting mode: sec

Emissions Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	1170	1130	12	12
HC, FID, ppm C	1640	1740	--	--
CO, NDIR, %	0.30	0.30	--	--
CO_2, NDIR, %	0.63	0.61	--	--
NO_x, Saltz, ppm NO_2	68	63	3	3
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0765	0.0717
HC, FID, lb/mile	0.1117	0.1178
CO, NDIR, lb/mile	0.419	0.410
CO_2, NDIR, lb/mile	1.300	1.235
NO_x, Saltz, lb/mile	0.014	0.013
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	130	131

---

*Corrected for background

TABLE D-88. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-10 Date Inspected May 21, 1969

Vehicle Description
Make/year Dodge / 1963
Odometer, miles 88,331
Source/service City of San Antonio / City maintenance

GVW, lb 23,000 Tire Size 900 X 20
Engine CID/cylinders 318 / V-8
Transmission type/speeds New Process Gear Div (Manual) /5
Axles, drive/dead 1 / 0 N/V 62.9

Preparation Data
At 30 mph level road, manifold vacuum was 18.5 in Hg resulting in 10 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 10 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: sec

Emissions Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	490	438	102	102
HC, FID, ppm C	735	620	--	--
CO, NDIR, %	0.278	0.275	--	--
CO_2, NDIR, %	0.57	0.51	--	--
NO_x, Saltz, ppm NO_2	45	54	6	6
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0272	0.0221
HC, FID, lb/mile	0.0497	0.0418
CO, NDIR, lb/mile	0.380	0.374
CO_2, NDIR, lb/mile	1.14	0.990
NO_x, Saltz, lb/mile	0.0083	0.0086
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	112	102

---

*Corrected for background

TABLE D-89. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV 11 Date Inspected May 21, 1968

Vehicle Description
Make/year Dodge / 1965
Odometer, miles 263,279
Source/service City of San Antonio / Street maintenance
GVW, lb 26,500 Tire Size 900 X 20
Engine CID/cylinders 318 / V 8
Transmission type/speeds New Process/Gear Div (Manual) / 5
Axles, drive/dead 1 / 0 N/V 63.9

Preparation Data
At 30 mph level road, manifold vacuum was 18.5 in. Hg resulting in 10 hp rear wheel power (obs) at 1775 rpm engine speed. Timing was 14 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting mode: -- sec

Emissions, Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	426	426	102	102
HC, FID, ppm C	560	380	--	--
CO, NDIR, %	0.30	0.40	--	--
CO_2, NDIR, %	0.67	0.59	--	--
NO_x, Saltz, ppm NO_2	44	39	9	9
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0237	0.0220
HC, FID, lb/mile	0.0475	0.0386
CO, NDIR, lb/mile	0.400	0.320
CO_2, NDIR, lb/mile	1.33	1.17
NO_x, Saltz, lb/mile	0.0082	0.0086
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	116	97

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[a] Corrected for background

TABLE D-90. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV 12 Date Inspected May 21, 1968

Vehicle Description
Make/year IHC / 1960
Odometer, miles 2807
Source/service City of San Antonio / Shrubbery collection
GVW, lb 21,000 Tire Size 900 X 20
Engine CID/cylinders 265 / V 8
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 37.5

Preparation Data
At 30 mph level road, manifold vacuum was 18.0 in. Hg resulting in 8 hp rear wheel power (obs) at 1725 rpm engine speed. Timing was 9 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment No time adjustments were made; however initial shifting points for this 4 speed vehicle were 15 mph in 2nd, 20 mph in 3rd, and 25 mph in 4th

Time to reach end of accel shifting mode: -- sec

Emissions, Concentration Basis	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	270	270	102	102
HC, FID, ppm C	360	330	--	--
CO, NDIR, %	0.183	0.178	--	--
CO_2, NDIR, %	0.58	0.50	--	--
NO_x, Saltz, ppm NO_2	46	46	8	8
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]	Run 1	Run 2
HC, NDIR, lb/mile	0.0123	0.0120
HC, FID, lb/mile	0.246	0.0224
CO, NDIR, lb/mile	0.282	0.243
CO_2, NDIR, lb/mile	1.11	1.12
NO_x, Saltz, lb/mile	0.0088	0.0088
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	115	161

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[a] Corrected for background

TABLE D-91. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-13 Date Inspected August 20, 1968

Vehicle Description
Make/year Chevrolet / 1968
Odometer, miles 4370
Source/service ABC Rental / Moving van
GVW, lb 24,000 Tire Size 900 X 20
Engine CID/cylinders 327 / V-8
Transmission type/speeds New Process/Lear Dh (Manual)/4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 17.5 in. Hg resulting in 9.00 rear wheel power (bhp) at 1800 rpm engine speed. Timing was 4 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment No time adjustments made; however, initial shifting points for this 4-speed vehicle were 15 mph in 2nd, 27 mph in 3rd, and 35 mph in 4th.

Time to reach end of accel shifting modes sec

Emissions Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	120	110	70	45
HC, FID, ppm C	610	590	—	—
CO, NDIR, %	0.263	0.213	—	—
CO_2, NDIR, %	1.0	1.0	—	—
NO_x, Saltz, ppm NO_2	92	93	—	—
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0179	0.0184
HC, FID, lb/mile	0.0380	0.0384
CO, NDIR, lb/mile	0.347	0.303
CO_2, NDIR, lb/mile	2.210	2.110
NO_x, Saltz, lb/mile	0.0213	0.0213
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	167	167

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*Corrected for background

TABLE D-92. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-14 Date Inspected August 29, 1968

Vehicle Description
Make/year GMC / 1966
Odometer, miles 18,893
Source/service ABC Rental / Van, rental
GVW, lb 20,000 Tire Size 900 X 20
Engine CID/cylinders 305 / V-6
Transmission type/speeds GMC Manual / 4
Axles, drive/dead 1 / 0 N/V 51.7

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 8.00 rear wheel power (bhp) at 1550 rpm engine speed. Timing was 6 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment No time adjustments were made; however, initial shifting modes were 15 mph in 2nd, 28 mph in 3rd, and 35 mph in 4th for this 4-speed transmission.

Time to reach end of accel shifting modes — sec

Emissions Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	210	200	20	30
HC, FID, ppm C	380	380	—	—
CO, NDIR, %	0.10	0.09	—	—
CO_2, NDIR, %	0.7	0.8	—	—
NO_x, Saltz, ppm NO_2	131	162	—	—
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0130	0.0127
HC, FID, lb/mile	0.0258	0.0275
CO, NDIR, lb/mile	0.1370	0.1270
CO_2, NDIR, lb/mile	1.510	1.740
NO_x, Saltz, lb/mile	0.0298	0.0375
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	218	260

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*Corrected for background

TABLE D-93. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-15

Date Inspected September 6, 1968

Vehicle Description

Make/year Chevrolet / 1968

Odometer, miles 1942

Source/service Southwest Research Institute / Buildings and Grounds Maintenance

GVW, lb 22,000 Tire Size 900 X 20

Engine CID/cylinders 327 / V-8

Transmission type/speeds Chevrolet (Manual) / 5

Axles, drive/dead 1 / 0 N/V 53.8

Preparation Data

At 30 mph level road, manifold vacuum was 16.5 in. Hg resulting in 8 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 8 °BTC at 350 rpm idle.

Observed engine condition Fair

Cycle Adjustment No time adjustments were made, however initial shifting points for this 5-speed vehicle were 12 mph in 2nd, 27 mph in 3rd, and 33 mph in 4th.

Time to reach end of accel shifting mode: -- sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	220	200	70	70
HC, FID, ppm C	320	270	--	--
CO, NDIR, %	0.11	0.11	--	--
CO_2, NDIR, %	8.7	8.7	--	--
NO_x, Saltz, ppm NO_2	88	89	--	--
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0109	0.0087
HC, FID, lb/mile	0.0226	0.0173
CO, NDIR, lb/mile	0.137	0.120
CO_2, NDIR, lb/mile	1.370	1.440
NO_x, Saltz, lb/mile	0.0163	0.0149
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	112	101

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*Corrected for background

TABLE D-94. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-16

Date Inspected September 10, 1968

Vehicle Description

Make/year Ford / 1967

Odometer, miles 16,922

Source/service City of San Antonio / Street maintenance

GVW, lb 16,500 Tire Size 900 X 20

Engine CID/cylinders 330 / V-8

Transmission type/speeds New Process Lead Div (Manual)/5

Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data

At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 7 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 14 °BTC at 600 rpm idle.

Observed engine condition Good

Cycle Adjustment None

Time to reach end of accel shifting mode: -- sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	380	320	60	30
HC, FID, ppm C	625	570	--	--
CO, NDIR, %	0.18	0.17	--	--
CO_2, NDIR, %	8.8	8.8	--	--
NO_x, Saltz, ppm NO_2	92	92	--	--
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0321	0.0209
HC, FID, lb/mile	0.0446	0.0408
CO, NDIR, lb/mile	0.254	0.251
CO_2, NDIR, lb/mile	1.350	1.360
NO_x, Saltz, lb/mile	0.0217	0.0217
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	96	93

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*Corrected for background

TABLE D-95. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-17 Date Inspected September 11, 1968

Vehicle Description
Make/year Ford / 1967
Odometer, miles 15,319
Source/service City of San Antonio / Street repair

GVW, lb 24,000 Tire Size 900 X 20
Engine CID/cylinders 330 / V-8
Transmission type/speeds Clark Equipment Co (Manual) / 5
Axles, drive/dead 1 / 0 N/V 26.3

Preparation Data
At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 8.00 rear wheel power (obs) at 1850 rpm engine speed. Timing was 10 °BTC at 720 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 63 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	330	304	43	43
HC, FID, ppm C	570	540	——	——
CO, NDIR, %	0.14	0.133	——	——
CO_2, NDIR, %	0.7	0.8	——	——
NO_x, Saltz, ppm NO_2	163	162	——	——
NO, NDIR, ppm NO	——	——	——	——

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0201	0.0174
HC, FID, lb/mile	0.0400	0.0364
CO, NDIR, lb/mile	0.1983	0.1670
CO_2, NDIR, lb/mile	1.365	1.750
NO_x, Saltz, lb/mile	0.0376	0.0369
NO, NDIR, lb/mile	——	——
Exhaust flow, SCF/mile	121	125

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[a] Corrected for background

TABLE D-96. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-18 Date Inspected September 11, 1968

Vehicle Description
Make/year Ford / 1967
Odometer, miles 14,900
Source/service City of San Antonio / Street repair

GVW, lb 24,000 Tire Size 900 X 20
Engine CID/cylinders 330 / V-8
Transmission type/speeds Clark Equip. Co (Manual) / 5
Axles, drive/dead 1 / 0 N/V 26.3

Preparation Data
At 30 mph level road, manifold vacuum was 12.5 in. Hg resulting in 5.00 rear wheel power (obs) at 1900 rpm engine speed. Timing was 12 °BTC at 670 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 55 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	340	330	60	60
HC, FID, ppm C	533	570	——	——
CO, NDIR, %	0.125	0.130	——	——
CO_2, NDIR, %	0.8	0.8	——	——
NO_x, Saltz, ppm NO_2	82	69	——	——
NO, NDIR, ppm NO	——	——	——	——

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0238	0.0232
HC, FID, lb/mile	0.0402	0.0399
CO, NDIR, lb/mile	0.1835	0.1880
CO_2, NDIR, lb/mile	1.810	1.820
NO_x, Saltz, lb/mile	0.0220	0.0186
NO, NDIR, lb/mile	——	——
Exhaust flow, SCF/mile	144	139

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[a] Corrected for background

TABLE D-97. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-19 Date Inspected September 18, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 1435
Source/service City of San Antonio / Garbage disposal
GVW, lb 27,500 Tire Size 10.00 X 20
Engine CID/cylinders 345 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 86.6

Preparation Data
At 30 mph level road, manifold vacuum was 12.6 in. Hg resulting in 8.80 rear wheel power (obs) at 1700 rpm engine speed. Timing was 10 °BTC at 600 rpm idle.
Observed engine condition Good
Cycle Adjustment Automatic selector was set in 3rd through 6th speeds. A 10 in. vac setting was held until truck shifted into 6th gear and a 3 in vac setting was then held until vehicle speed was 33 mph. This operation was a representative accel to speed. WOT operation caused nonrepresentative shifting of the automatic transmission.
Time to reach end of accel shifting mode: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	270	270	30	30
HC, FID, ppm C	530	550	—	—
CO, NDIR, %	0.33	0.36	—	—
CO_2, NDIR, %	1.0	1.0	—	—
NO_x, Saltz, ppm NO_2	113	113	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0169	0.0169
HC, FID, lb/mile	0.0370	0.0380
CO, NDIR, lb/mile	0.492	0.501
CO_2, NDIR, lb/mile	2.210	2.200
NO_x, Saltz, lb/mile	0.0219	0.0217
NO, NDIR, lb/mile	—	—
Exhaust flow, ft³/mile	168	170

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[a] Corrected for background

TABLE D-98. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-20 Date Inspected September 19, 1968

Vehicle Description
Make/year Dodge / 1966
Odometer, miles 32,103
Source/service City of San Antonio / Employee transportation
GVW, lb 23,000 Tire Size 9.00 X 20
Engine CID/cylinders 361 / V-8
Transmission type/speeds New Process Gear Div (Manual)/5
Axles, drive/dead 1 / 0 N/V 57.5

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 5.50 rear wheel power (obs) at 1600 rpm engine speed. Timing was 8 °BTC at 630 rpm idle.
Observed engine condition Fair
Cycle Adjustment None
Time to reach end of accel shifting mode: 60 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	290	310	43	60
HC, FID, ppm C	475	530	—	—
CO, NDIR, %	0.21	0.21	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	115	115	15	15
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0167	0.0205
HC, FID, lb/mile	0.0321	0.0356
CO, NDIR, lb/mile	0.286	0.286
CO_2, NDIR, lb/mile	1.710	1.710
NO_x, Saltz, lb/mile	0.0186	0.0188
NO, NDIR, lb/mile	—	—
Exhaust flow, ft³/mile	127	130

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[a] Corrected for background

TABLE D-99. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-21 Date Inspected September 20, 1968

Vehicle Description
Make/year Dodge / 1965
Odometer, miles 76,283
Source/service City of San Antonio / Garbage collection

GVW, lb 23,000 Tire Size 900 X 20
Engine CID/cylinders 318 / V-8
Transmission type/speeds New Process/Clark Div (Manual)/4
Axles, drive/dead 1 / 0 N/V 36.7

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 2.0 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 14 °BTC at 720 rpm idle.
Observed engine condition Fair
Cycle Adjustment No time adjustments made; however, initial shifting points for this 4 speed vehicle were 13 mph in 2nd, 26 mph in 3rd, and 33 mph in 4th.

Time to reach end of accel shifting modes: 19 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	340	310	45	45
HC, FID, ppm C	310	310	—	—
CO, NDIR, %	0.21	0.20	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz, ppm NO_2	93	89	23	33
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0130	0.0161
HC, FID, lb/mile	0.0349	0.0336
CO, NDIR, lb/mile	0.2960	0.272
CO_2, NDIR, lb/mile	1.940	1.83
NO_x, Saltz, lb/mile	0.0167	0.0109
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	146	172

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[a] Corrected for background

TABLE D-100. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-22 Date Inspected September 24, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 15,056
Source/service City of San Antonio / Garbage collection

GVW, lb 27,500 Tire Size 10.00 X 20
Engine CID/cylinders 345 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 48.6

Preparation Data
At 30 mph level road, manifold vacuum was 12.5 in. Hg resulting in 5.0 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 14 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment Automatic selector was set in 2nd through 6th speeds. A 10 in. vac setting was held until truck shifted into 6th gear and a 3 in. setting was held until vehicle speed was 25 mph. This operation was a representative accel to speed. WOT operation caused nonrepresentative shifting of the automatic transmission.
Time to reach end of accel shifting modes: 32 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	300	—	30	—
HC, FID, ppm C	550	—	—	—
CO, NDIR, %	0.39	—	—	—
CO_2, NDIR, %	1.0	—	—	—
NO_x, Saltz, ppm NO_2	69	21	—	—
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0126	—
HC, FID, lb/mile	0.0396	—
CO, NDIR, lb/mile	0.363	—
CO_2, NDIR, lb/mile	1.270	—
NO_x, Saltz, lb/mile	0.0126	—
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	214	—

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[a] Corrected for background

TABLE D-101. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-33 Date Inspected September 23, 1968

Vehicle Description
Make/year GMC / 1967
Odometer, miles 1174
Source/service City of San Antonio / Garbage collection
GVW, lb 27,500 Tire Size 10.00 X 20
Engine CID/cylinders 348 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 48.6

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 3.00 rear wheel power (obs) at 1700 rpm engine speed. Timing was 14 °BTC at 530 rpm idle.
Observed engine condition Fair
Cycle Adjustment Automatic selector was set in 3rd through 6th speeds. A 10-in. vac setting was held until truck shifted into 6th gear and a 3-in setting was held until vehicle speed was 35 mph. The operation was a representative accel to speed. WOT operation caused nonrepresentative shifting of the automatic transmission.
Time to reach end of accel shifting modes: —

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	260	240	30	20
HC, FID, ppm C	430	410	—	—
CO, NDIR, %	0.21	0.22	—	—
CO_2, NDIR, %	1.1	1.1	—	—
NO_x, Saltz, ppm NO_2	115	115	18	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0167	0.0160
HC, FID, lb/mile	0.0310	0.0293
CO, NDIR, lb/mile	0.305	0.320
CO_2, NDIR, lb/mile	2.320	2.320
NO_x, Saltz, lb/mile	0.0173	0.0223
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	173	173

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*Corrected for background

TABLE D-102. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-34 Date Inspected September 26, 1968

Vehicle Description
Make/year Ford / 1964
Odometer, miles 11,037
Source/service City of San Antonio / Garbage collection [illegible]
GVW, lb 25,500 Tire Size 900 X 20
Engine CID/cylinders 361 / V-8
Transmission type/speeds Clark Eaton Co (Manual) / 5
Axles, drive/dead 1 / 0 N/V 57.5

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 3.00 rear wheel power (obs) at 1600 rpm engine speed. Timing was 18 °BTC at 550 rpm idle.
Observed engine condition Fair
Cycle Adjustment None
Time to reach end of accel shifting modes: 35 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	410	450	40	40
HC, FID, ppm C	680	760	—	—
CO, NDIR, %	0.17	0.18	—	—
CO_2, NDIR, %	1.1	1.1	—	—
NO_x, Saltz, ppm NO_2	157	200	46	46
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0248	0.0279
HC, FID, lb/mile	0.0432	0.0510
CO, NDIR, lb/mile	0.230	0.240
CO_2, NDIR, lb/mile	3.120	3.380
NO_x, Saltz, lb/mile	0.0266	0.0370
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	167	167

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*Corrected for background

TABLE D-103. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-25 Date Inspected September 27, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 71,035
Source/service City of San Antonio / Garbage collection
Tractor
GVW, lb 32,000 Tire Size 10.00 X 20
Engine CID/cylinders 332 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 48.6

Preparation Data
At 30 mph level road, manifold vacuum was 13 in. Hg resulting in 12.0 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 14 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 58 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	510	560	30	30
HC, FID, ppm C	910	980	—	—
CO, NDIR, %	0.43	0.46	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	59	46	23	—
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0316	0.0370
HC, FID, lb/mile	0.0596	0.0680
CO, NDIR, lb/mile	0.393	0.645
CO_2, NDIR, lb/mile	1.680	1.760
NO_x, Saltz, lb/mile	0.0106	0.0106
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	200	230

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*Corrected for background

TABLE D-104. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-26 Date Inspected September 30, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 3300
Source/service City of San Antonio / Garbage collection
GVW, lb 27,500 Tire Size 10.00 X 20
Engine CID/cylinders 345 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 48.6

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 9.00 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 13 °BTC at 420 rpm idle.
Observed engine condition Good
Cycle Adjustment Automatic selector was set in 3rd through 6th gear speed range. A 10-in. vac setting was held through 3rd, 4th, and 5th. A 3-in. vac setting was held in 6th gear until vehicle speed reached 35 mph. This operation was a representative accel. WOT operation caused nonrepresentative shifting of the automatic transmission.
Time to reach end of accel shifting modes: 52 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	590	570	30	30
HC, FID, ppm C	1070	990	—	—
CO, NDIR, %	0.30	0.30	—	—
CO_2, NDIR, %	1.0	1.0	—	—
NO_x, Saltz, ppm NO_2	115	115	23.1	23.1
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0405	0.0383
HC, FID, lb/mile	0.0770	0.0698
CO, NDIR, lb/mile	0.4360	0.4270
CO_2, NDIR, lb/mile	2.284	2.238
NO_x, Saltz, lb/mile	0.0227	0.0226
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	130	130

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*Corrected for background

TABLE D-105. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-27 Date Inspected October 1, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 73,906
Source/service City of San Antonio / Garbage collection
Packer
GVW, lb 25,000 Tire Size 10.00 X 20
Engine CID/cylinders 332 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 33

Preparation Data
At 30 mph level road, manifold vacuum was 13.5 in. Hg resulting in 18 hp rear wheel power (obs) at 1650 rpm engine speed. Timing was 15 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment Automatic selector was set in 3rd through 6th gear range. An 8.5 in. vac was held through 3rd, 4th, and 5th 6th gear until vehicle speed reached 25 mph. This operation was representative of a rapid accel. WOT operation caused nonrepresentative shifting of the automatic transmission.
Time to reach end of accel shifting modes: 18 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	320	330	60	60
HC, FID, ppm C	410	430	--	--
CO, NDIR, %	0.42	0.42	--	--
CO_2, NDIR, %	0.7	0.7	--	--
NO_x, Saltz. ppm NO_2	69	69	23	23
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0186	0.0193
HC, FID, lb/mile	0.0359	0.0370
CO, NDIR, lb/mile	0.395	0.392
CO_2, NDIR, lb/mile	1,339	1,330
NO_x, Saltz. lb/mile	0.0112[a]	0.0113
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	187	186

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[a] Corrected for background

TABLE D-106. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-28 Date Inspected October 2, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 2123
Source/service ABC Rental / Tractor, rental
GVW, lb 32,000 Tire Size 10.00 X 20
Engine CID/cylinders 450 / I6
Transmission type/speeds Fuller (Manual) / 5
Axles, drive/dead 1 / 0 N/V 30.1

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 20 hp rear wheel power (obs) at 1300 rpm engine speed. Timing was 14 °BTC at 280 rpm idle.
Observed engine condition Good
Cycle Adjustment None
Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	500	460	60	60
HC, FID, ppm C	960	780	--	--
CO, NDIR, %	0.51	0.50	--	--
CO_2, NDIR, %	0.7	0.7	--	--
NO_x, Saltz. ppm NO_2	92	92	26	23
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0319	0.0296
HC, FID, lb/mile	0.0616	0.0517
CO, NDIR, lb/mile	0.638	0.630
CO_2, NDIR, lb/mile	1,590	1,570
NO_x, Saltz. lb/mile	0.0121	0.0168
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	199	200

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[a] Corrected for background

TABLE D-107. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-29 Date Inspected October 3, 1968

Vehicle Description
Make/year Chevrolet / 1966
Odometer, miles 50,240
Source/service Avis Rental / Tractor, rental

GVW, lb 25,000 Tire Size 10.00 × 20
Engine CID/cylinders 366 / V-8
Transmission type/speeds Spicer Div Dana Corp (Manual)/5
Axles, drive/dead 1 / 0 N/V 50.1

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 28.50 rear wheel power (obs) at 1600 rpm engine speed. Timing was 11 °BTC at 700 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 22 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	360	370	40	40
HC, FID, ppm C	610	640	—	—
CO, NDIR, %	0.25	0.23	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	92	92	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0212	0.0220
HC, FID, lb/mile	0.0399	0.0430
CO, NDIR, lb/mile	0.291	0.340
CO_2, NDIR, lb/mile	1,660	1,630
NO_x, Saltz, lb/mile	0.0156	0.0157
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	188	187

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*Corrected for background

TABLE D-108. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-30 Date Inspected October 4, 1968

Vehicle Description
Make/year Chevrolet / 1966
Odometer, miles 4593
Source/service Avis Rental / Tractor, rental

GVW, lb 25,000 Tire Size 10.00 × 20
Engine CID/cylinders 366 / V-8
Transmission type/speeds Chevrolet (Manual) / 5
Axles, drive/dead 1 / 0 N/V 48.6

Preparation Data
At 30 mph level road, manifold vacuum was 13.5 in. Hg resulting in 23.00 rear wheel power (obs) at 2300 rpm engine speed. Timing was 14 °BTC at 700 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 23 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	290	250	40	40
HC, FID, ppm C	480	420	—	—
CO, NDIR, %	0.16	0.14	—	—
CO_2, NDIR, %	0.6	0.6	—	—
NO_x, Saltz, ppm NO_2	92	69	36	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0176	0.0148
HC, FID, lb/mile	0.0252	0.0291
CO, NDIR, lb/mile	0.221	0.196
CO_2, NDIR, lb/mile	1,330	1,320
NO_x, Saltz, lb/mile	0.0102	0.0112
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	134	143

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*Corrected for background

TABLE D-109. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-31 Date Inspected October 8, 1968

Vehicle Description
Make/year Ford / 1963
Odometer, miles 53,535
Source/service City Public Service Board / Utility line repair and construction
GVW, lb 24,000 Tire Size 900 X 20
Engine CID/cylinders 332 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 37.5

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 8.00 rear wheel power (rhp) at 1900 rpm engine speed. Timing was 14 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment Automatic selector was set in 3rd through 6th gear. A 9-in. vac was maintained through the 3rd, 4th, 5th, and 6th gears.
Time to reach end of accel shifting modes: 52 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	720	780	40	40
HC, FID, ppm C	1180	1220	—	—
CO, NDIR, %	0.285	0.28	—	—
CO_2, NDIR, %	0.40	1.10	—	—
NO_x, Saltz, ppm NO_2	149	149	28	36
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0461	0.0478
HC, FID, lb/mile	0.0796	0.0829
CO, NDIR, lb/mile	0.402	0.398
CO_2, NDIR, lb/mile	2,100	2,370
NO_x, Saltz, lb/mile	0.0264	0.0219
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	186	178

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*Corrected for background

TABLE D-110. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-32 Date Inspected October 10, 1968

Vehicle Description
Make/year Ford / 1967
Odometer, miles 8633
Source/service City Public Service Board / Supply transportation
GVW, lb 20,000 Tire Size 750 X 20
Engine CID/cylinders 300 / L6
Transmission type/speeds New Process Gear Div (Manual) / 4
Axles, drive/dead 1 / 0 N/V 66.6

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 14.00 rear wheel power (rhp) at 2000 rpm engine speed. Timing was 14 °BTC at 460 rpm idle.
Observed engine condition Good
Cycle Adjustment Adjustments were made to obtain a minimum shifting mode time for the 4-speed transmission. Adjustments were to these shifting points that were 12 mph in 2nd, 25 mph in 3rd and 35 mph in 4th.
Time to reach end of accel shifting modes: 58 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	240	220	30	30
HC, FID, ppm C	440	400	—	—
CO, NDIR, %	0.19	0.22	—	—
CO_2, NDIR, %	0.6	0.7	—	—
NO_x, Saltz, ppm NO_2	92	115	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0160	0.0144
HC, FID, lb/mile	0.0314	0.0284
CO, NDIR, lb/mile	0.274	0.313
CO_2, NDIR, lb/mile	1,263	1,572
NO_x, Saltz, lb/mile	0.0189	0.0221
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	101	118

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*Corrected for background

TABLE D-111. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-33 Date Inspected October 14, 1968

Vehicle Description
Make/year IHC / 1966
Odometer, miles 19,647
Source/service City Public Service Board / Utility line maintenance
GVW, lb 22,000 Tire Size 825 X 20
Engine CID/cylinders 304 / V-8
Transmission type/speeds IHC
Axles, drive/dead 1 / 0 N/V 6.13

Preparation Data
At 30 mph level road, manifold vacuum was 10 in. Hg resulting in 13 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 16 °BTC at 400 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	310	330	30	30
HC, FID, ppm C	570	690	--	--
CO, NDIR, %	0.21	0.30	--	--
CO_2, NDIR, %	0.8	0.8	--	--
NO_x, Saltz, ppm NO_2	115	92	46	33
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0195	0.0216
HC, FID, lb/mile	0.380	0.0433
CO, NDIR, lb/mile	0.422	0.434
CO_2, NDIR, lb/mile	1.740	1.818
NO_x, Saltz, lb/mile	0.0167	0.0162
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	127	141

*Corrected for background

TABLE D-112. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-34 Date Inspected October 15, 1968

Vehicle Description
Make/year IHC / 1966
Odometer, miles 17,532
Source/service City Public Service Board / Utility line maintenance with "Hi Ranger"
GVW, lb 22,000 Tire Size 825 X 20
Engine CID/cylinders 304 / V-8
Transmission type/speeds IHC / 5
Axles, drive/dead 1 / 0 N/V 6.13

Preparation Data
At 30 mph level road, manifold vacuum was 13.5 in. Hg resulting in 12 hp rear wheel power (obs) at 1700 rpm engine speed. Timing was 12 °BTC at 400 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 60 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	310	340	30	30
HC, FID, ppm C	550	610	--	--
CO, NDIR, %	0.25	0.23	--	--
CO_2, NDIR, %	0.10	0.10	--	--
NO_x, Saltz, ppm NO_2	115	117	46	46
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0201	0.0221
HC, FID, lb/mile	0.0391	0.0433
CO, NDIR, lb/mile	0.360	0.329
CO_2, NDIR, lb/mile	2.360	2.250
NO_x, Saltz, lb/mile	0.0174	0.0177
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	180	177

*Corrected for background

TABLE D-113. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-35 Date Inspected October 18, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 1891
Source/service City Public Service Board / Utility line maintenance with "Hi Ranger"
GVW, lb 32,000 Tire Size 825 X 20
Engine CID/cylinders 304 / V-8
Transmission type/speeds IHC / 5
Axles, drive/dead 1 / 0 N/V 60.5

Preparation Data
At 30 mph level road, manifold vacuum was 14.6 in. Hg resulting in 9.0hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 11 °BTC at 520 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting mode: 17 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	240	300	30	30
HC, FID, ppm C	430	540	—	—
CO, NDIR, %	0.33	0.34*	—	—
CO_2, NDIR, %	0.9	0.10	—	—
NO_x, Saltz, ppm NO_2	69	37	23	23
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0149	0.0182
HC, FID, lb/mile	0.289	0.0361
CO, NDIR, lb/mile	0.431	0.463
CO_2, NDIR, lb/mile	1.920	2.130
NO_x, Saltz, lb/mile	0.0108	0.0070
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	150	169

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*Corrected for background

TABLE D-114. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-36 Date Inspected October 22, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 12,717
Source/service City Public Service Board / Utility line maintenance with "Hi Ranger"
GVW, lb 25,500 Tire Size 900 X 20
Engine CID/cylinders 392 / V-8
Transmission type/speeds Allison / 6
Axles, drive/dead 1 / 0 N/V 39.3

Preparation Data
At 30 mph level road, manifold vacuum was 17 in. Hg resulting in 10 hp rear wheel power (obs) at 1740 rpm engine speed. Timing was 14 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment Selector was placed in 3rd through 6th gear selection. A 3-in. vac setting was maintained to simulate actual automatic shifting through the shifting modes acceleration. WOT operation produced abnormal shifting.

Time to reach end of accel shifting mode: 59 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	300	330	40	40
HC, FID, ppm C	500	570	—	—
CO, NDIR, %	0.32	0.34	—	—
CO_2, NDIR, %	0.10	0.10	—	—
NO_x, Saltz, ppm NO_2	113	113	23	46
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0176	0.0203
HC, FID, lb/mile	0.0342	0.0391
CO, NDIR, lb/mile	0.440	0.473
CO_2, NDIR, lb/mile	2.190	2.181
NO_x, Saltz, lb/mile	0.0216	0.0167
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	163	159

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*Corrected for background

TABLE D-115. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-37 Date Inspected October 23, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 13,342
Source/service City Public Service Board / Utility line construction with "Hi Ranger"
GVW, lb 32,300 Tire Size 900 X 20
Engine CID/cylinders 392 / V-8
Transmission type/speeds Allison / 6
Axles, drive/dead 1 / 0 N/V 59.3

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 8 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 18 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment Selector was placed in 3rd through 6th gear selection. A 8-in. vac was held in the 3rd, 4th, and 5th gear and a 1-in. vac was held in 6th gear until 35 mph was reached. WOT operation in the accel mode produced unrealistic shifting.
Time to reach end of accel shifting modes: 81 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	380	420	40	40
HC, FID, ppm C	660	740	—	—
CO, NDIR, %	0.49	0.49	—	—
CO_2, NDIR, %	1.1	1.1	—	—
NO_x, Saltz, ppm NO_2	92	98	23	13
NO, NDIR, ppm NO	—	—	—	—

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0228	0.0237
HC, FID, lb/mile	0.0448	0.0508
CO, NDIR, lb/mile	0.672	0.680
CO_2, NDIR, lb/mile	2.374	2.399
NO_x, Saltz, lb/mile	0.0161	0.0163
NO, NDIR, lb/mile	—	—
Exhaust flow, SCF/mile	244	172

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*Corrected for background

TABLE D-116. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-38 Date Inspected October 24, 1968

Vehicle Description
Make/year IHC / 1966
Odometer, miles 27,938
Source/service City Public Service Board / Utility line construction with "Hi Ranger"
GVW, lb 22,000 Tire Size 825 X 20
Engine CID/cylinders 304 / V-8
Transmission type/speeds IHC / 5
Axles, drive/dead 1 / 0 N/V 62.5

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 9 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 10 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment None
Time to reach end of accel shifting modes: 62 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	270	288	20	20
HC, FID, ppm C	493	530	—	—
CO, NDIR, %	0.37	0.32	—	—
CO_2, NDIR, %	0.8	0.8	—	—
NO_x, Saltz, ppm NO_2	92	92	23	23
NO, NDIR, ppm NO	160	130	60	30

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0172	0.0186
HC, FID, lb/mile	0.0343	0.0374
CO, NDIR, lb/mile	0.316	0.423
CO_2, NDIR, lb/mile	1.744	1.761
NO_x, Saltz, lb/mile	0.0164	0.0161
NO, NDIR, lb/mile	0.0186	0.0157
Exhaust flow, SCF/mile	132	132

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*Corrected for background

TABLE D-117. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV 39 Date Inspected October 25, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 1174
Source/service City Public Service Board / Utility easement maintenance
GVW, lb 22,000 Tire Size 900 X 20
Engine CID/cylinders 345 / V-8
Transmission type/speeds IHC / 5
Axles, drive/dead 1 / 0 N/V 34.0

Preparation Data
At 30 mph level road, manifold vacuum was 11.5 in. Hg resulting in 14 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 14 °BTC at 400 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 34 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	270	290	45	48
HC, FID, ppm C	450	490	—	—
CO, NDIR, %	0.18	0.19	—	—
CO_2, NDIR, %	0.8	0.6	—	—
NO_x, Saltz, ppm NO_2	97	69	46	23
NO, NDIR, ppm NO	163	168	63	70

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0161	0.0176
HC, FID, lb/mile	0.0318	0.0348
CO, NDIR, lb/mile	0.258	0.273
CO_2, NDIR, lb/mile	1.800	1.356
NO_x, Saltz, lb/mile	0.0112	0.0116
NO, NDIR, lb/mile	0.0160	0.0157
Exhaust flow, SCF/mile	126	98

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*Corrected for background

TABLE D-118. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV 40 Date Inspected October 25, 1968

Vehicle Description
Make/year IHC / 1967
Odometer, miles 1363
Source/service City Public Service Board / Utility line construction
GVW, lb 32,500 Tire Size 900 X 20
Engine CID/cylinders 392 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 1 / 0 N/V 33.1

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 9 hp rear wheel power (obs) at 1650 rpm engine speed. Timing was 12 °BTC at 700 rpm idle.
Observed engine condition Fair
Cycle Adjustment Selector was set at 2nd through 6th gears. A 7.5-in. vac setting was held through the 3rd, 4th, and 5th gears and a 2-in. vac setting was maintained in the 6th gear until 35 mph was reached. WOT operation caused unrealistic shifting.
Time to reach end of accel shifting modes: 62 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	250	280	20	20
HC, FID, ppm C	460	440	—	—
CO, NDIR, %	0.28	0.31	—	—
CO_2, NDIR, %	1.1	1.1	—	—
NO_x, Saltz, ppm NO_2	69	69	23	23
NO, NDIR, ppm NO	140	180	40	60

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0162	0.155
HC, FID, lb/mile	0.0318	0.0307
CO, NDIR, lb/mile	0.510	0.457
CO_2, NDIR, lb/mile	2.45	2.43
NO_x, Saltz, lb/mile	0.0112	0.0109
NO, NDIR, lb/mile	0.0163	0.0189
Exhaust flow, SCF/mile	152	178

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*Corrected for background

TABLE D-119. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-41 Date Inspected October 31, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 1905
Source/service City Public Service Board / Dump truck
GVW, lb 22,000 Tire Size 900 X 20
Engine CID/cylinders 345 / V8
Transmission type/speeds IHC / 5
Axles, drive/dead 1 / 0 N/V 66.2

Preparation Data
At 30 mph level road, manifold vacuum was 16.5 in. Hg resulting in 7 hp. rear wheel power (obs) at 1700 rpm engine speed. Timing was 12 °BTC at 420 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 58 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	300	310	60	60
HC, FID, ppm C	470	500	--	--
CO, NDIR, %	0.120	0.13	--	--
CO_2, NDIR, %	0.7	0.8	--	--
NO_x, Saltz. ppm NO_2	111.5	93.4	46.2	46.2
NO, NDIR, ppm NO	220	220	130	130

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0173	0.0169
HC, FID, lb/mile	0.0340	0.0330
CO, NDIR, lb/mile	0.185	0.2010
CO_2, NDIR, lb/mile	1.570	1.890
NO_x, Saltz. lb/mile	0.171	0.0133
NO, NDIR, lb/mile	0.133	0.147
Exhaust flow, SCF/mile	152	180

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*Corrected for background

TABLE D-120. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-42 Date Inspected October 31, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 1629
Source/service City Public Service Board / Utility easement maintenance
GVW, lb 22,000 Tire Size 900 X 20
Engine CID/cylinders 345 / V8
Transmission type/speeds IHC / 5
Axles, drive/dead 1 / 0 N/V 66.1

Preparation Data
At 30 mph level road, manifold vacuum was 16.3 in. Hg resulting in 7 hp. rear wheel power (obs) at 1700 rpm engine speed. Timing was 12 °BTC at 400 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 57 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	430	420	50	50
HC, FID, ppm C	720	700	--	--
CO, NDIR, %	0.235	0.220	--	--
CO_2, NDIR, %	0.7	0.8	--	--
NO_x, Saltz. ppm NO_2	65	92	23	46
NO, NDIR, ppm NO	190	195	120	120

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0276	0.0262
HC, FID, lb/mile	0.0519	0.0491
CO, NDIR, lb/mile	0.347	0.312
CO_2, NDIR, lb/mile	1.605	1.782
NO_x, Saltz. lb/mile	0.0114	0.0138
NO, NDIR, lb/mile	0.0122	0.137
Exhaust flow, SCF/mile	133	120

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*Corrected for background

TABLE D-121. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-43 Date Inspected December 3, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 1001
Source/service City Public Service Board / Line pole transportation
GVW, lb 34,100 Tire Size 10.00 X 20
Engine CID/cylinders 406 / I-6
Transmission type/speeds Std. (Manual) / 5
Axles, drive/dead 1 / 0 hp/V 20.2

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 14 hp rear wheel power (obs) at 1500 rpm engine speed. Timing was 0 °BTC at 480 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 50 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	320	340	30	30
HC, FID, ppm C	330	370	--	--
CO, NDIR, %	0.14	0.16	--	--
CO_2, NDIR, %	0.9	0.9	--	--
NO_x, Saltz, ppm NO_2	115	115	12	12
NO, NDIR, ppm NO	160	170	40	40

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0197	0.0212
HC, FID, lb/mile	0.0377	0.0408
CO, NDIR, lb/mile	0.198	0.232
CO_2, NDIR, lb/mile	2.004	2.010
NO_x, Saltz, lb/mile	0.0213	0.0220
NO, NDIR, lb/mile	0.0189	0.0209
Exhaust flow, SCF/mile	182	182

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[a] Corrected for background

TABLE D-122. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-44 Date Inspected December 3, 1968

Vehicle Description
Make/year IHC / 1968
Odometer, miles 980
Source/service City Public Service Board / Cable transport trucks
GVW, lb 34,100 Tire Size 10.00 X 20
Engine CID/cylinders 406 / I-6
Transmission type/speeds Std. (Manual) / 5
Axles, drive/dead 1 / 0 hp/V 20.1

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 14 hp rear wheel power (obs) at 1550 rpm engine speed. Timing was 4 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 54 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	355	380	30	30
HC, FID, ppm C	580	610	--	--
CO, NDIR, %	0.12	0.115	--	--
CO_2, NDIR, %	1.20	1.20	--	--
NO_x, Saltz, ppm NO_2	162	162	12	12
NO, NDIR, ppm NO	220	210	20	20

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0229	0.0232
HC, FID, lb/mile	0.0414	0.0425
CO, NDIR, lb/mile	0.170	0.164
CO_2, NDIR, lb/mile	2.679	2.659
NO_x, Saltz, lb/mile	0.0304	0.0318
NO, NDIR, lb/mile	0.0265	0.0249
Exhaust flow, SCF/mile	174	184

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[a] Corrected for background

TABLE D-123. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-45 Date Inspected December 4, 1968

Vehicle Description
Make/year Ford / 1966
Odometer, miles 12,399
Source/service City Public Service Board / Line construction - Crane
GVW, lb 17,000 Tire Size 10.00 X 20
Engine CID/cylinders 361 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 2 / 0 N/V 49.7

Preparation Data
At 30 mph level road, manifold vacuum was 12.5 in. Hg resulting in 12 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 10 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment Specified WOT operation was employed. Automatic transmission shifting point was 12 mph to 4th, 17 mph to 5th, and 23 mph to 6th.

Time to reach end of accel shifting modes: 58 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	330	290	30	30
HC, FID, ppm C	370	400	--	--
CO, NDIR, %	0.41	0.37	--	--
CO_2, NDIR, %	1.2	1.0	--	--
NO_x, Saltz, ppm NO_2	138.6	138.6	46	46
NO, NDIR, ppm NO	180	180	40	30

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0206	0.0185
HC, FID, lb/mile	0.0397	0.0388
CO, NDIR, lb/mile	0.569	0.525
CO_2, NDIR, lb/mile	2,620	2,230
NO_x, Saltz, lb/mile	0.0211	0.0215
NO, NDIR, lb/mile	0.0203	0.0204
Exhaust flow, SCF/mile	312	176

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[a] Corrected for background

TABLE D-124. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-46 Date Inspected December 4, 1968

Vehicle Description
Make/year Diamond T / 1958
Odometer, miles 42,294
Source/service City Public Service Board / Electrical repair
GVW, lb 22,000 Tire Size 825 X 20
Engine CID/cylinders 264 / L-6
Transmission type/speeds (Manual) / 4
Axles, drive/dead 1 / 0 N/V 51.5

Preparation Data
At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 9 hp rear wheel power (obs) at -- rpm engine speed. Timing was 10 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 17 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	380	370	30	30
HC, FID, ppm C	630	620	--	--
CO, NDIR, %	0.37	0.365	--	--
CO_2, NDIR, %	0.8	0.8	--	--
NO_x, Saltz, ppm NO_2	92	92	46	46
NO, NDIR, ppm NO	145	142	30	30

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0247	0.0233
HC, FID, lb/mile	0.0436	0.0424
CO, NDIR, lb/mile	0.528	0.484
CO_2, NDIR, lb/mile	1,780	1,720
NO_x, Saltz, lb/mile	0.0116	0.0113
NO, NDIR, lb/mile	0.0151	0.0146
Exhaust flow, SCF/mile	183	182

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[a] Corrected for background

TABLE D-125. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-47

Date Inspected December 5, 1968

Vehicle Description
Make/year IHC / 1962
Odometer, miles 63,782
Source/service City Public Service Board / Multipurpose tractor
GVW, lb 29,000 Tire Size 10.00 X 20
Engine CID/cylinders 406 / I-6
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 31.0

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 5 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 10 °BTC at 520 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 82 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	420	475	20	30
HC, FID, ppm C	820	890	--	--
CO, NDIR, %	0.34	0.33	--	--
CO_2, NDIR, %	1.20	1.1	--	--
NO_x, Saltz, ppm NO_2	69	69	23	23
NO, NDIR, ppm NO	170	150	60	60

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0330	0.0341
HC, FID, lb/mile	0.0670	0.0680
CO, NDIR, lb/mile	0.325	0.309
CO_2, NDIR, lb/mile	2.91	2.66
NO_x, Saltz, lb/mile	0.0117	0.0123
NO, NDIR, lb/mile	0.0193	0.0178
Exhaust flow, SCF/mile	333	310

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[a] Corrected for background.

TABLE D-126. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-48

Date Inspected December 5, 1968

Vehicle Description
Make/year Ford / 1961
Odometer, miles
Source/service City Public Service Board / Lineman service with crane
GVW, lb 35,000 Tire Size 10.00 X 20
Engine CID/cylinders 292 / V-8
Transmission type/speeds Allison (Automatic) / 6
Axles, drive/dead 2 / 0 N/V 16.6

Preparation Data
At 30 mph level road, manifold vacuum was 12 in. Hg resulting in 5 hp rear wheel power (obs) at 1600 rpm engine speed. Timing was 14 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment Shift points for acceleration shifting mode were 13 mph in 4th, 22 mph in 5th, and to 35 mph in 6th. WOT operation was employed in the 3rd-6th gear selection.

Time to reach end of accel shifting modes: 81 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	340	350	50	60
HC, FID, ppm C	460	540	--	--
CO, NDIR, %	0.39	0.44	--	--
CO_2, NDIR, %	1.7	1.4	--	--
NO_x, Saltz, ppm NO_2	152	162	46	46
NO, NDIR, ppm NO	130	140	60	74

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0208	0.0210
HC, FID, lb/mile	0.0380	0.0382
CO, NDIR, lb/mile	0.530	0.498
CO_2, NDIR, lb/mile	3.660	3.130
NO_x, Saltz, lb/mile	0.0274	0.0283
NO, NDIR, lb/mile	0.0115	0.0112
Exhaust flow, SCF/mile	370	322

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[a] Corrected for background.

TABLE D-127. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-49 Date Inspected December 6, 1968

Vehicle Description
Make/year IHC / 1962
Odometer, miles 49,165
Source/service City Public Service Board / Single axle winch
GVW, lb 23,300 Tire Size 10.00 X 20
Engine CID/cylinders 406 / I-6
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 31.0

Preparation Data
At 30 mph level road, manifold vacuum was 13.5 in. Hg resulting in 13.0 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 6 °BTC at 520 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 61 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	440	460	60	60
HC, FID, ppm C	745	820	--	--
CO, NDIR, %	0.24	0.27	--	--
CO_2, NDIR, %	1.0	1.1	--	--
NO_x, Saltz, ppm NO_2	115	115	46	46
NO, NDIR, ppm NO	180	180	60	60

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0294	0.0301
HC, FID, lb/mile	0.0770	0.0807
CO, NDIR, lb/mile	0.370	0.404
CO_2, NDIR, lb/mile	2.420	2.380
NO_x, Saltz, lb/mile	0.0186	0.0181
NO, NDIR, lb/mile	0.0207	0.0202
Exhaust flow, SCF/mile	135	198

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[a] Corrected for background

TABLE D-128. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-50 Date Inspected December 6, 1968

Vehicle Description
Make/year IHC / 1964
Odometer, miles [illegible]
Source/service City Public Service Board / Post hole digger
GVW, lb 29,000 Tire Size 900 X 20
Engine CID/cylinders 304 / V-8
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 2 / 0 N/V 30.6

Preparation Data
At 30 mph level road, manifold vacuum was 13.8 in. Hg resulting in 8 hp rear wheel power (obs) at 1900 rpm engine speed. Timing was 4 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes 71 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	365	380	30	30
HC, FID, ppm C	685	700	--	--
CO, NDIR, %	0.30	0.30	--	--
CO_2, NDIR, %	1.20	1.10	--	--
NO_x, Saltz, ppm NO_2	139	139	46	69
NO, NDIR, ppm NO	207	200	60	60

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0252	0.0264
HC, FID, lb/mile	0.0540	0.0522
CO, NDIR, lb/mile	0.452	0.454
CO_2, NDIR, lb/mile	2.840	2.610
NO_x, Saltz, lb/mile	0.0240	0.0161
NO, NDIR, lb/mile	0.0768	0.0236
Exhaust flow, SCF/mile	237	187

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[a] Corrected for background

TABLE D-129. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-51

Date Inspected December 12, 1968

Vehicle Description

Make/year IHC / 1968
Odometer, miles 4659
Source/service N.S. Ind. School Dist / School bus
GVW, lb 23,000 Tire Size 900 X 20
Engine CID/cylinders 304 / V 8
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 48.4

Preparation Data

At 30 mph level road, manifold vacuum was 13 in. Hg resulting in 5 hp. rear wheel power (obs) at 1450 rpm engine speed. Timing was 0 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 61 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	150	130	60	30
HC, FID, ppm C	535	490	--	--
CO, NDIR, %	0.11	0.12	--	--
CO_2, NDIR, %	0.9	0.9	--	--
NO_x, Saltz. ppm NO_2	97	115	22	22
NO, NDIR, ppm NO	170	180	75	60

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0226	0.0206
HC, FID, lb/mile	0.0810	0.0772
CO, NDIR, lb/mile	0.170	0.184
CO_2, NDIR, lb/mile	2,190	2,170
NO_x, Saltz. lb/mile	0.0183	0.0238
NO, NDIR, lb/mile	0.0163	0.0206
Exhaust flow, SCF/mile	192	198

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[a] Corrected for background

TABLE D-130. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-52

Date Inspected December 13, 1968

Vehicle Description

Make/year IHC / 1968
Odometer, miles 5570
Source/service N.S. Ind. School Dist / School bus
GVW, lb 23,000 Tire Size 900 X 20
Engine CID/cylinders 304 / V8
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 48.4

Preparation Data

At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 5 hp. rear wheel power (obs) at 1450 rpm engine speed. Timing was 0 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 56 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	120	120	30	30
HC, FID, ppm C	490	450	--	--
CO, NDIR, %	0.17	0.15	--	--
CO_2, NDIR, %	0.9	0.9	--	--
NO_x, Saltz. ppm NO_2	97	115	22	22
NO, NDIR, ppm NO	130	130	43	43

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0231	0.0232
HC, FID, lb/mile	0.0392	0.0421
CO, NDIR, lb/mile	0.270	0.240
CO_2, NDIR, lb/mile	2,240	2,260
NO_x, Saltz. lb/mile	0.0186	0.0229
NO, NDIR, lb/mile	0.0183	0.0187
Exhaust flow, SCF/mile	204	216

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[a] Corrected for background

TABLE D-131. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-53 Date Inspected December 16, 1968

Vehicle Description
Make/year Dodge / 1962
Odometer, miles 30,065
Source/service N.S. Ind. School Dist / School bus

GVW, lb 22,000 Tire Size 900 X 20
Engine CID/cylinders 318 / V-8
Transmission type/speeds New Process (Manual) / 5
Axles, drive/dead 1 / 0 N/V 66.6

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 7 hp rear wheel power (obs) at 2100 rpm engine speed. Timing was 10 °BTC at 600 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 55 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	1150	1130	30	30
HC, FID, ppm C	1900	1870	--	--
CO, NDIR, %	0.32	0.29	--	--
CO_2, NDIR, %	0.8	0.8	--	--
NO_x, Saltz, ppm NO_2	69	69	33	33
NO, NDIR, ppm NO	145	130	73	73

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0804	0.0777
HC, FID, lb/mile	0.1380	0.1340
CO, NDIR, lb/mile	0.469	0.419
CO_2, NDIR, lb/mile	1.830	1.820
NO_x, Saltz, lb/mile	0.0114	0.0116
NO, NDIR, lb/mile	0.0125	0.0116
Exhaust flow, SCF/mile	198	213

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*Corrected for background.

TABLE D-132. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-54 Date Inspected December 17, 1968

Vehicle Description
Make/year IHC / 1959
Odometer, miles 98,102
Source/service N.S. Ind. School Dist / School bus

GVW, lb 21,000 Tire Size 900 X 20
Engine CID/cylinders 282 / I-6
Transmission type/speeds IHC (Manual) / 5
Axles, drive/dead 1 / 0 N/V 30.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in [illegible] rear wheel power (obs) at 1500 rpm engine speed. Timing was 10 °BTC at 400 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 64 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	470	440	30	30
HC, FID, ppm C	820	760	--	--
CO, NDIR, %	0.22	0.225	--	--
CO_2, NDIR, %	0.9	0.8	--	--
NO_x, Saltz, ppm NO_2	115	113	46	46
NO, NDIR, ppm NO	180	190	110	110

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0244	0.0290
HC, FID, lb/mile	0.0478	0.0439
CO, NDIR, lb/mile	0.314	0.321
CO_2, NDIR, lb/mile	2.020	1.790
NO_x, Saltz, lb/mile	0.0171	0.0169
NO, NDIR, lb/mile	0.0120	0.0134
Exhaust flow, SCF/mile	153	131

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*Corrected for background

TABLE D-133. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-55

Date Inspected December 18, 1968

Vehicle Description

Make/year Ford / 1955
Odometer, miles 133,135
Source/service N.S. Ind. School Dist / School bus

GVW, lb 21,000 Tire size 825 X 20
Engine CID/cylinders 292 / V8
Transmission type/speeds Ford (Manual) / 5
Axles, drive/dead 1 / 0 N/V 58.3

Preparation Data

At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 13.80 rear wheel power (rhp) at 1750 rpm engine speed. Timing was 12 °BTC at 380 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 60 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	175	160	25	25
HC, FID, ppm C	300	285	—	—
CO, NDIR, %	0.085	0.105	—	—
CO_2, NDIR, %	0.9	0.9	—	—
NO_x, Saltz. ppm NO_2	185	179	46	46
NO, NDIR, ppm NO	130	145	30	30

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0120	0.0110
HC, FID, lb/mile	0.0236	0.0223
CO, NDIR, lb/mile	0.135	0.166
CO_2, NDIR, lb/mile	2,350	2,340
NO_x, Saltz. lb/mile	0.0361	0.0282
NO, NDIR, lb/mile	0.0210	0.0201
Exhaust flow, SCF/mile	236	245

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[a] Corrected for background

TABLE D-134. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-56

Date Inspected December 19, 1968

Vehicle Description

Make/year Dodge / 1963
Odometer, miles 69,338
Source/service N.S. Ind. School Dist / School bus

GVW, lb 21,000 Tire size 900 X 20
Engine CID/cylinders 361 / V8
Transmission type/speeds New Process (Manual) / 5
Axles, drive/dead 1 / 0 N/V 56.7

Preparation Data

At 30 mph level road, manifold vacuum was 14.5 in. Hg resulting in 10.90 rear wheel power (rhp) at 1700 rpm engine speed. Timing was 8 °BTC at 600 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 55 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	325	380	35	35
HC, FID, ppm C	990	1080	—	—
CO, NDIR, %	0.44	0.46	—	—
CO_2, NDIR, %	0.7	0.7	—	—
NO_x, Saltz. ppm NO_2	69	93	21	46
NO, NDIR, ppm NO	110	120	45	45

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0322	0.0390
HC, FID, lb/mile	0.0757	0.0770
CO, NDIR, lb/mile	0.672	0.661
CO_2, NDIR, lb/mile	1,709	1,890
NO_x, Saltz. lb/mile	0.0111	0.0109
NO, NDIR, lb/mile	0.0173	0.0120
Exhaust flow, SCF/mile	312	198

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[a] Corrected for background

TABLE D-135. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-57 Date Inspected December 20, 1968

Vehicle Description
Make/year Ford / 1955
Odometer, miles 126,354
Source/service E.S. Ind. School Dist / School bus

GVW, lb 21,000 Tire Size 825 X 20
Engine CID/cylinders 292 / V-8
Transmission type/speeds Ford (Manual) / 5
Axles, drive/dead 1 / 0 N/V 38.1

Preparation Data
At 30 mph level road, manifold vacuum was 14.0 in. Hg resulting in 3 hp. rear wheel power (obs) at 1750 rpm engine speed. Timing was 12 °BTC at 800 rpm idle.
Observed engine condition Fair
Cycle Adjustment Non

Time to reach end of accel shifting modes: 60 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	330	380	60	60
HC, FID, ppm C	500	535	--	--
CO, NDIR, %	0.225	0.20	--	--
CO_2, NDIR, %	9.8	9.8	--	--
NO_x, Saltz. ppm NO_2	69	68	21	21
NO, NDIR, ppm NO	145	160	70	70

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0163	0.0199
HC, FID, lb/mile	0.0328	0.0360
CO, NDIR, lb/mile	0.346	0.334
CO_2, NDIR, lb/mile	1.710	1.700
NO_x, Saltz. lb/mile	0.0109	0.0108
NO, NDIR, lb/mile	0.0119	0.0142
Exhaust flow, SCF/mile	170	181

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*Corrected for background.

APPENDIX E

SUMMARY TABLES LISTING (RANKING) BASELINE EMISSIONS FROM GASOLINE POWERED VEHICLES

TABLE E-1. CHRONOLOGICAL SUMMARY OF CLASS II BASELINE EMISSION TESTS

(Gasoline Powered)

Test No.	Year	Make	Vehicle Mileage	Engine Displacement, in³	No. of Cylinders	GVW, lb	A/F Ratio	Engine Condition	HC(IR), [illegible]	HC(FIA), [illegible]	CO, [illegible]	CO₂, [illegible]	NOₓ, [illegible]	NO, [illegible]	Exh Flow, SCFM	Ranking HC(IR)	CO	NOₓ	Total	HC Ratio, FIA/IR
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]												
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Avg						[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					

TABLE E-2. CLASS II CO BASELINE EMISSIONS SUMMARY

(Ranked from Low to High)

Run No.	Year	Make	Vehicle Mileage	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	Engine Condition	HCIR, lb/mi	HCFIA, lb/mi	CO, lb/mi	CO$_2$, lb/mi	NO$_x$, lb/mi	NO, lb/mi	Exh Flow, SCF/mi	Rank
II-4	1962	Ford	85,196	223	6	9,800	66.7	Fair	0.0327	0.0614	0.175	1.877	0.0288	0.0288	154.5	1
II-19	1959	Chev	7,704	235	6	9,600	56.7	Fair	0.0395	0.0744	0.216	1.915	0.0134	0.0132	178.5	1
II-28	1960	Ford	49,949	223	6	7,400	55.0	Good	0.0249	0.0465	0.229	2.386	0.0154	0.0084	229.5	1
II-5	1968	IHC	601	304	8	10,000	53.3	Good	0.0276	0.0552	0.241	1.895	0.0153	0.0106	194.5	1
II-7	1967	IHC	1,226	304	8	9,800	53.3	Good	0.0333	0.0629	0.242	1.545	0.0156	0.0150	135.5	1
II-31	1968	Chev	6,050	250	6	10,000	53.4	Good	0.0189	0.0375	0.250	1.300	0.0108		131.5	1
II-17	1959	Chev	99,367	235	6	9,600	56.7	Fair	0.0227	0.0395	0.264	1.725	0.0106	0.0124	153.5	1
II-22	1966	Ford	25,027	240	6	10,000	51.7	Fair	0.0330	0.0594	0.277	1.965	0.0180	0.0170	179.0	1
II-9	1966	Ford	29,195	240	6	10,000	53.3	Fair	0.0279	0.0534	0.280	1.885	0.0207	0.0206	152.5	1
II-20	1967	Ford	26,795	240	6	6,000	43.3	Fair	0.0327	0.0596	0.281	1.538	0.0053	0.0047	143.0	1
II-2	1965	Chev	45,723	230	6	10,000	55.0	Fair	0.0205	0.0379	0.282	1.135	0.0109	–	108.5	2
II-21	1969	Chev	1,394	250	6	10,000	51.7	Good	0.0191	0.0359	0.283	1.470	0.0106	0.0104	173.5	2
II-30	1960	Ford	57,909	223	6	7,400	58.3	Fair	0.0207	0.0426	0.301	1.619	0.0122	0.0093	149.5	2
II-6	1962	Dodge	4,951	225	6	10,000	53.3	Fair	0.0254	0.0454	0.307	1.542	0.0155	0.0126	128.0	2
II-3	1968	IHC	51	304	8	10,000	51.7	Good	0.0304	0.0652	0.311	1.640	0.0154	0.0107	147.5	2
II-15	1966	Ford	27,095	240	6	10,000	58.6	Good	0.0165	0.0360	0.319	2.305	0.0192	0.0194	202.5	2
II-25	1962	Ford	86,223	223	6	10,000	58.0	Fair	0.0506	0.0985	0.336	1.692	0.0106	0.0123	156.5	2
II-32	1957	Ford	32,045	300	6	6,000	47.5	Fair	0.0304	0.0575	0.339	1.297	0.0056	0.0040	145.0	2
II-18	1964	Ford	77,555	223	6	10,000	65.0	Poor	0.0496	0.0882	0.391	1.775	0.0150	0.0132	180.0	2
II-27	1966	Ford	29,606	240	6	7,500	43.3	Fair	0.0171	0.0356	0.396	1.280	0.0110	0.0077	129.0	2
II-1	1963	Ford	88,086	223	6	9,800	60.0	Fair	0.0240	0.0482	0.398	1.566	0.0565	–	138.0	3
II-10	1968	Dodge	552	318	8	10,050	53.3	Good	0.0237	0.0469	0.399	1.611	0.0100	0.0106	156.0	3
II-8	1966	Ford	24,795	240	6	10,300	56.7	Fair	0.0234	0.0462	0.401	1.960	0.0130	0.0122	159.0	3
II-23	1968	Chev	4,864	250	6	7,500	58.0	Fair	0.0363	0.0660	0.409	1.850	0.0119	0.0114	180.5	3
II-29	1968	Chev	716	250	6	7,500	46.7	Good	0.0189	0.0389	0.421	1.640	0.0079	0.0079	134.5	3
II-24	1966	Ford	17,202	240	6	10,000	51.7	Fair	0.0173	0.0375	0.430	2.002	0.0101	0.0077	310.0	3
II-16	1966	Ford	27,770	240	6	10,001	50.0	Good	0.0236	0.0470	0.440	2.130	0.0160	0.0164	201.5	3
II-11	1965	Ford	44,290	240	6	10,000	56.7	Fair	0.0386	0.0714	0.455	1.485	0.0162	0.0151	151.5	3
II-12	1968	Dodge	195	318	8	10,000	53.3	Good	0.0383	0.0358	0.485	2.345	0.0104	0.0135	176.0	3
II-13	1964	Ford	–	223	6	10,000	56.7	Fair	0.0509	0.0921	0.504	1.365	0.0052	0.0083	143.0	3
Avg						9,230	55.5		0.0276	0.0530	0.339	1.757	0.0136	0.0121	156.8	
II-26	1966	Ford	Engine Condition Poor – Run not completed!													

TABLE E-1. CLASS II HC (NDIR) BASELINE EMISSIONS SUMMARY

(Ranked from Low to High)

Run No.	Year	Make	Vehicle Mileage	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	Engine Condition	HC(IR), lb/mi	HC(FIA), lb/mi	CO, lb/mi	CO_2, lb/mi	NO_x, lb/mi	NO, lb/mi	Exh Flow SCF/mi	Rank
II-15	1966	Ford	27,595	240	6	10,000	50.0	Good	0.0168	0.0360	0.319	2.385	0.0092	0.0191	203.5	1
II-27	1966	Ford	29,694	240	6	7,500	43.3	Fair	0.0171	0.0356	0.396	1.200	0.0010	0.0077	125.0	1
II-29	1966	Ford	17,303	240	6	10,000	51.7	Fair	0.0173	0.0373	0.438	3.010	0.0101	0.0077	125.0	1
II-32	1968	Dodge	185	318	8	10,000	53.3	Good	0.0180	0.0358	0.485	2.345	0.0104	0.0135	176.0	1
II-21	1969	Chev	1,396	250	6	10,000	51.7	Good	0.0181	0.0359	0.283	1.470	0.0116	0.0104	173.5	1
II-20	1968	Chev	216	250	6	7,500	46.7	Good	0.0189	0.0389	0.421	1.640	0.0079	0.0079	134.5	1
II-31	1969	Chev	6,050	250	6	10,000	53.4	Good	0.0194	0.0375	0.250	1.300	0.0104	—	151.5	1
II-2	1965	Chev	45,732	230	6	10,000	55.0	Poor	0.0203	0.0379	0.302	1.125	0.0100	—	109.5	1
II-30	1960	Ford	57,909	223	6	7,400	58.3	Fair	0.0207	0.0426	0.281	1.610	0.0112	0.0093	181.5	1
II-17	1959	Chev	99,367	235	6	9,600	56.7	Fair	0.0227	0.0393	0.264	1.725	0.0106	0.0124	153.5	1
II-9	1966	Ford	24,785	240	6	10,000	56.7	Fair	0.0234	0.0462	0.401	1.960	0.0120	0.0125	159.0	2
II-14	1966	Ford	27,770	240	6	10,000	50.0	Good	0.0236	0.0470	0.440	2.130	0.0160	0.0164	201.5	2
II-10	1968	Dodge	552	318	8	10,000	53.3	Good	0.0237	0.0469	0.390	1.831	0.0106	0.0156	122.0	2
II-1	1963	Ford	86,806	223	6	3,800	60.0	Fair	0.0240	0.0482	0.399	1.560	0.0162	—	134.0	2
II-28	1966	Ford	48,949	223	6	7,495	55.0	Good	0.0248	0.0465	0.239	2.300	0.0154	0.0084	229.5	2
II-6	1962	Dodge	4,951	225	6	10,000	53.3	Fair	0.0254	0.0454	0.307	1.542	0.0153	0.0129	128.0	2
II-5	1966	IHC	306	304	8	10,000	53.3	Good	0.0276	0.0552	0.241	1.895	0.0153	0.0106	194.5	2
II-8	1966	Ford	29,105	240	6	10,000	53.3	Fair	0.0278	0.0534	0.280	1.885	0.0207	0.0206	152.5	2
II-3	1968	IHC	51	304	8	10,000	51.7	Good	0.0304	0.0652	0.311	1.680	0.0154	0.0107	147.5	2
II-25	1967	Ford	32,045	240	6	6,000	47.5	Fair	0.0304	0.0575	0.358	1.297	0.0056	0.0040	145.0	2
II-24	1967	Ford	26,785	240	6	6,300	43.3	Fair	0.0327	0.0596	0.281	1.530	0.0055	0.0047	143.0	3
G-4	1963	Ford	83,196	223	6	9,000	66.7	Fair	0.0327	0.0634	0.175	1.677	0.0208	0.0201	158.5	3
II-22	1966	Ford	25,827	240	6	10,000	51.7	Fair	0.0330	[illegible]	0.277	1.965	0.0100	0.0170	179.0	3
II-7	1967	IHC	1,226	304	8	8,800	53.3	Good	0.0353	[illegible]	0.242	1.595	0.0156	0.0150	135.5	3
II-23	1968	Chev	4,064	250	6	7,500	50.0	Fair	0.0367	0.0660	0.409	1.850	0.0110	0.0134	196.5	3
II-11	1965	Ford	552	240	6	10,000	56.7	Good	0.0384	0.0734	0.455	1.485	0.0162	0.0151	151.5	3
II-19	1959	Chev	7,704	235	6	9,600	56.7	Fair	0.0395	0.0744	0.216	1.915	0.0134	0.0138	176.5	3
II-39	1964	Ford	77,555	223	6	10,000	65.0	Poor	0.0496	0.0902	0.391	1.775	0.0156	0.0132	180.0	3
II-16	1961	Ford	94,223	223	6	10,000	50.0	Fair	0.0540	0.0903	0.336	1.692	0.0106	0.0123	156.5	3
II-13	1964	Ford	—	223	6	10,000	56.7	Fair	0.0509	0.0921	0.504	1.305	0.0099	0.0083	143.0	3
Avg.						9,250	53.4		0.0279	0.0538	0.339	1.757	0.0130	0.0121	157.0	
II-26	1966	Ford		240	6	10,000	50.0	Engine Condition Poor – Runs not completed								

TABLE E-4. CLASS II NO$_x$ BASELINE EMISSIONS SUMMARY
(Ranked from Low to High)

Run No.	Year	Make	Vehicle Mileage	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	Engine Condition	HC/IR, lb/mi	HC/FID, lb/mi	CO, lb/mi	CO$_2$, lb/mi	NO$_x$, lb/mi	NO, lb/mi	Exh Flow, SCFM	Rank
II-28	1967	Ford	26,705	240	6	6,000	43.3	Fair	0.0327	0.0596	0.282	1.530	0.0053	0.0047	143.0	1
II-25	1967	Ford	32,045	240	6	6,000	47.5	Fair	0.0384	0.575	0.258	1.297	0.0054	0.0040	145.0	1
II-20	1968	Chev	278	250	6	7,500	46.7	Good	0.0189	0.0389	0.423	1.640	0.0079	0.0079	134.5	1
II-13	1964	Ford		223	6	10,000	56.7	Fair	0.0509	0.0921	0.594	1.395	0.0099	0.0065	143.0	1
II-29	1966	Ford	17,303	240	6	10,000	51.7	Fair	0.0175	0.0575	0.430	3.010	0.0101	0.0077	125.0	1
II-12	1969	Dodge	185	318	8	10,000	53.3	Good	0.0180	0.0358	0.485	2.145	0.0104	0.0125	176.0	1
II-2	1965	Ford	45,732	230	6	10,000	75.0	Poor	0.0265	0.0579	0.282	1.125	0.0106	–	189.5	1
II-21	1969	Chev	1,394	250	6	10,200	51.7	Good	0.0181	0.0259	0.283	1.470	0.0106	0.0104	173.5	1
II-16	1961	Ford	86,221	223	6	10,000	50.0	Fair	0.0508	0.0905	0.336	1.692	0.0106	0.0123	156.6	1
II-17	1959	Chev	99,367	235	6	9,600	56.7	Fair	0.0227	0.0395	0.264	1.725	0.0106	0.0126	153.5	1
II-23	1969	Chev	4,064	250	6	7,506	50.0	Fair	0.0363	0.0660	0.409	1.839	0.0110	0.0034	180.5	2
II-27	1966	Ford	29,604	240	6	7,500	43.3	Fair	0.0171	0.0356	0.396	1.290	0.0110	0.0077	125.0	2
II-30	1966	Ford	57,989	223	6	7,400	52.3	Fair	0.0207	0.0426	0.340	1.610	0.0112	0.0053	149.5	2
II-9	1966	Ford	24,785	240	6	10,000	56.7	Fair	0.0234	0.0462	0.401	1.960	0.0136	0.0125	159.0	2
II-19	1959	Chev	7,784	235	6	9,600	56.7	Fair	0.0295	0.0744	0.216	1.905	0.0134	0.0138	178.5	2
II-6	1962	Dodge	4,951	225	6	10,000	53.3	Fair	0.0254	0.0454	0.397	1.542	0.0155	0.0129	129.0	2
II-5	1968	IHC	601	304	8	10,400	53.3	Good	0.0276	0.0552	0.241	1.295	0.0153	0.0106	196.5	2
II-3	1968	IHC	51	304	8	10,000	51.7	Good	0.0366	0.0562	0.311	1.680	0.0154	0.0097	147.5	2
II-26	1968	Ford	40,949	223	6	7,400	55.0	Good	0.0240	0.0495	0.256	2.300	0.0154	0.0086	229.5	2
II-7	1967	IHC	1,226	304	8	8,800	53.3	Good	0.0333	0.0679	0.242	1.585	0.0156	0.0150	135.5	2
II-18	1964	Ford	77,555	223	6	10,500	65.0	Poor	0.0496	0.0882	0.391	1.775	0.0159	0.0132	180.0	3
II-14	1966	Ford	22,770	240	6	10,000	50.0	Good	0.0236	0.0470	0.442	2.130	0.0166	0.0164	201.5	3
II-11	1965	Ford	44,291	240	6	10,000	56.7	Fair	0.0384	0.0714	0.425	1.485	0.0167	0.0151	191.5	3
II-1	1963	Ford	89,806	223	6	9,800	60.0	Fair	0.0340	0.0482	0.386	1.566	0.0165	–	138.0	3
II-22	1966	Ford	25,827	240	6	10,000	51.7	Fair	0.0330	0.0594	0.277	1.965	0.0180	0.0170	170.6	3
II-31	1966	Chev	6,050	250	6	10,000	53.4	Good	0.0189	0.0375	0.250	1.780	0.0184	–	132.5	3
II-10	1968	Dodge	552	318	8	10,020	53.3	Good	0.0237	0.0469	0.366	1.811	0.0186	0.0156	152.0	3
II-15	1966	Ford	27,095	240	6	11,000	50.0	Good	0.0168	0.0760	0.319	2.305	0.0192	0.0190	200.5	3
II-8	1966	Ford	29,105	240	6	11,000	53.3	Fair	0.0278	0.0534	0.260	1.885	0.0207	0.0206	152.5	3
II-4	1963	Ford	83,196	223	6	9,800	66.7	Fair	0.0327	0.0634	0.275	1.877	0.0200	0.0200	154.5	3
Avg.						9,230	53.3		0.0279	0.0539	0.339	1.757	0.0130	0.0121	157.0	

II-24 Engine Condition Poor - Run not completed

TABLE E-? CHRONOLOGICAL SUMMARY OF CLASS III BASELINE EMISSIONS TESTS

(Continued)

TABLE E-4 CLASS III CO BASELINE EMISSIONS SUMMARY
(Ranked from Low to High)

Run No.	Year	Make	Vehicle Mileage	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	Engine Condition	HC(IR), g/mi	HC(FID), g/mi	CO, g/mi	CO_2, g/mi	NO_x, g/mi	NO_2, g/mi	Exh Flow, SCFM	Rank
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	IHC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	1
[illegible]	[illegible]	Chev	—	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	—	2
[illegible]	[illegible]	Ford	—	[illegible]	[illegible]	[illegible]	[illegible]	Poor	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Dodge	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Ford	—	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	IHC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	2
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2
[illegible]	[illegible]	IHC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	3
[illegible]	[illegible]	Ford	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	IHC	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Good	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Poor	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3
[illegible]	[illegible]	Chev	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Fair	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	3
Avg			[illegible]			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

TABLE E-7 CLASS III HC (NDIR) BASELINE EMISSIONS SUMMARY
(Ranked from Low to High)

TABLE 5.4 CLASS III NO$_2$ BASELINE EMISSIONS SUMMARY
(Ranked from Low to High)

Run No.	Year	Make	Vehicle Mileage	Engine Displacement, in^3	No. of Cylinders	GVW, lb	N/V Ratio	Engine Condition	HC(FID), lb/min	HC(NDIR), lb/min	CO, lb/min	CO$_2$, lb/min	NO$_x$, lb/min	NO$_2$, lb/min	Exh Flow, SCFM	Rank
10-40	1958	IHC	45	304	8	10,000	53.3	Good	0.0220	0.0469	0.403	1.125	0.0054	0.0002	69	1
10-41	1958	IHC	76	304	8	10,000	55.0	Good	0.0318	0.0825	0.590	1.346	0.0055	0.0011	146	1
10-43	1967	Chev	16,457	292	6	16,000	60.0	Poor	0.0239	0.1219	0.677	1.295	0.0055	0.0067	135	1
10-46	1969	Chev	13,900	250	6	10,000	51.7	Good	0.0173	0.0365	0.312	1.540	0.0050	0.0093	190	1
10-8	1964	Ford	—	223	6	24,000	56.7	Poor	0.0190	0.1720	0.351	1.020	0.0066	—	165	1
10-10	1962	Ford	2,112	262	6	10,600	59.0	Fair	0.0317	0.0571	0.275	1.124	0.0077	—	139	1
10-6	1967	Chev	19,400	292	6	19,500	56.7	Good	0.0212	0.0405	0.309	1.472	0.0078	—	126	1
10-5	1968	Chev	2,275	250	6	10,000	51.7	Good	0.0217	0.0570	0.380	1.225	0.0092	—	100	1
10-9	1963	Ford	—	262	6	16,500	56.7	Good	0.0212	0.0300	0.305	1.500	0.0099	—	138	1
10-19	1956	Chev	69,000	261	6	10,000	53.3	Fair	0.0245	0.0495	0.513	1.235	0.0101	—	164	1
10-20	1960	Chev	89,320	235	6	19,500	58.0	Fair	0.0292	0.0662	0.860	2.202	0.0105	—	166	1
10-24	1967	Chev	15,706	292	6	16,000	56.7	Fair	0.0217	0.0422	0.376	1.563	0.0120	—	132	1
10-47	1969	Dodge	30	318	8	16,120	65.0	Good	0.0152	0.0642	0.373	2.238	0.0130	0.0041	276	1
10-22	1965	Ford	51,119	223	6	15,000	60.0	Good	0.0199	0.0335	0.370	1.756	0.0133	—	147	1
10-11	1963	Chev	61,900	292	6	17,000	58.3	Good	0.0188	0.0367	0.337	1.370	0.0134	—	128	1
10-15	1957	Chev	68,309	235	6	14,000	53.3	Fair	0.0206	0.0390	0.332	1.153	0.0137	—	105	2
10-14	1962	Ford	20,769	223	6	15,000	55.0	Fair	0.0275	0.0479	0.320	1.530	0.0142	—	126	2
10-44	1968	Chev	8,858	292	6	16,000	60.0	Fair	0.0035	0.0291	0.540	1.871	0.0151	0.0039	145	2
10-16	1961	Ford	74,921	292	8	16,000	46.7	Fair	0.0214	0.0307	0.447	2.150	0.0153	—	166	2
10-17	1957	Ford	19,648	292	8	17,000	51.7	Good	0.0260	0.0607	0.282	1.672	0.0156	—	149	2
10-37	1967	Chev	10,153	292	6	16,000	60.0	Fair	0.0300	0.0712	0.511	1.519	0.0158	0.0034	138	2
10-39	1967	Chev	9,262	292	6	16,209	45.0	Fair	0.0224	0.0405	0.479	1.407	0.0159	0.0076	122	2
10-21	1962	Ford	92,349	306	6	20,000	62.5	Good	0.0244	0.0466	0.343	1.395	0.0160	—	121	2
10-36	1967	Chev	5,872	292	6	16,000	43.3	Good	0.0274	0.0524	0.475	1.921	0.0162	0.0077	176	2
10-25	1966	Ford	19,402	240	6	17,000	60.0	Good	0.0276	0.0539	0.335	1.700	0.0167	—	172	2
10-7	1967	Chev	32,686	292	6	19,500	56.7	Good	0.0177	0.0331	0.319	1.682	0.0178	—	136	2
10-13	1959	Ford	31,062	292	8	14,000	60.0	Fair	0.0284	0.0445	0.391	2.095	0.0180	—	179	2
10-35	1959	IHC	68,376	282	6	19,500	56.7	Fair	0.0254	0.0513	0.311	2.565	0.0181	0.0046	178	2
10-28	1964	Ford	55,494	223	6	16,000	56.7	Fair	0.0209	0.0512	0.352	1.956	0.0183	0.0072	162	2
10-1	1965	Chev	—	230	6	19,500	64.2	Good	0.0278	0.0541	0.340	1.770	0.0185	—	—	2
10-12	1967	Ford	14,700	300	6	12,000	57.5	Good	0.0096	0.0224	0.275	1.758	0.0186	—	173	2
10-18	1960	Ford	102,035	292	8	16,300	55.0	Fair	0.0250	0.0460	0.536	2.100	0.0187	—	181	2
10-27	1964	Ford	68,779	223	6	16,000	56.7	Fair	0.0277	0.0534	0.352	1.414	0.0187	—	116	3
10-42	1967	Chev	14,237	292	6	16,000	60.0	Fair	0.0161	0.0325	0.342	1.506	0.0187	0.0074	120	3
10-38	1967	Chev	10,172	292	6	16,000	60.0	Fair	0.0197	0.0376	0.466	1.415	0.0191	0.0078	116	3
10-33	1967	Chev	8,981	250	6	16,000	60.0	Fair	0.0305	0.0562	0.399	1.725	0.0209	0.0095	159	3
10-31	1967	Chev	4,800	250	6	16,000	60.0	Fair	0.0269	0.0461	0.425	1.918	0.0210	0.0095	157	3
10-34	1959	IHC	150,110	282	6	16,500	56.7	Fair	0.0231	0.0471	0.395	1.829	0.0212	0.0086	152	3
10-30	1964	Ford	11,605	223	6	23,000	66.7	Fair	0.0212	0.0422	0.398	2.025	0.0213	0.0025	156	3
10-32	1967	Ford	54,101	262	6	19,500	60.0	Fair	0.0319	0.0592	0.445	1.945	0.0221	0.0070	176	3
10-23	1964	Ford	38,127	292	8	16,000	63.3	Fair	0.0293	0.0563	0.266	2.246	0.0223	—	173	3
10-29	1962	Ford	82,728	223	6	17,000	60.0	Fair	0.0273	0.0535	0.480	2.090	0.0224	0.0039	169	3
10-26	1966	Ford	26,672	240	6	17,000	66.7	Fair	0.0166	0.0309	0.486	2.082	0.0231	—	170	3
10-3	1966	Chev	27,206	292	6	19,500	55.0	Good	0.0169	0.0250	0.340	1.752	0.0238	—	150	3
10-45	1967	Chev	9,605	292	6	16,082	61.7	Fair	0.0137	0.0369	0.414	1.352	0.0246	0.0022	123	3
10-4	1965	Chev	35,331	292	6	19,500	60.8	Good	0.0171	0.0307	0.317	1.550	0.0350	—	146	3
10-2	1967	Ford	7,702	330	8	17,000	61.7	Good	0.0286	0.0516	0.250	1.950	0.0355	—	90	3
Avg			35,345			16,345	57.5		0.0241	0.0479	0.0440	1.702	0.0163	0.0062	149	

TABLE E-9 CHRONOLOGICAL SUMMARY OF CLASS IV BASELINE EMISSIONS TEST

(Gasoline Powered)

[illegible]

TABLE E-10 CLASS IV CO BASELINE EMISSIONS SUMMARY

[illegible]

TABLE E-11 CLASS IV HC (NDIR) BASELINE EMISSIONS SUMMARY

(Ranked from Low to High)

Run No.	Year	Make	Vehicle Mileage	Engine Displacement in³	No. of Cylinders	IVW lb	N/V Ratio	Engine Condition	HC/FID lb/mi	HC/NDIR lb/mi	CO lb/mi	CO₂ lb/mi	NOₓ lb/mi	SO₂ lb/mi	Exh Flow SCF/mi	Rank
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Avg			28,920			28,800	55.1		0.0266	0.0480	0.317	1.511	0.0169	0.0172	157	

TABLE E-12 CLASS IV NO_2 BASELINE EMISSIONS SUMMARY

(Ranked from Low to High)

Run No.	Year	Make	Vehicle Mileage	Engine Displacement in^3	No. of Cylinders	IVW lb	A/V Ratio	Engine Condition	HC-HB g/mi	HC-FID g/mi	CO g/mi	CO_2 g/mi	NO_x g/mi	NO g/mi	Fuel Econ. mi/gal	Rank
Avg			38,926			28,000	16.1		0.0750	0.0880	0.317	1.011	0.0169	0.0172	187	

APPENDIX F

LPG POWERED VEHICLE BASELINE EMISSIONS INSPECTION RESULTS

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TABLE F-1. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV 1 F Date Inspected December 12, 1968

Vehicle Description
Make/year IHC / 1963
Odometer, miles 191,180
Source/service Howell Refining Co / Tractor, tank transport
GVW, lb 27,000 Tire Size 10.00 X 20
Engine CID/cylinders 406 / 6
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 50.0

Preparation Data
At 30 mph level road, manifold vacuum was 17.0 in. Hg resulting in 22 hp rear wheel power (obs) at 1500 rpm engine speed. Timing was 10 °BTC at 650 rpm idle.
Observed engine condition Good
Cycle Adjustment Acceleration shifting mode points were 18 mph in 2nd, 24 mph in 3rd, and 31 mph in 4th for this 4-speed transmission vehicle.
Time to reach end of accel shifting modes: 75 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	120	120	25	25
HC, FID, ppm C	120	115	--	--
CO, NDIR, %	0.13	0.125	--	--
CO_2, NDIR, %	0.9	0.9	--	--
NO_x, Saltz, ppm NO_2	92	69	22	21
NO, NDIR, ppm NO	144	110	40	40

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0076	0.00685
HC, FID, lb/mile	0.0083	0.0081
CO, NDIR, lb/mile	0.1860	0.1770
CO_2, NDIR, lb/mile	1,030	1,010
NO_x, Saltz, lb/mile	0.0168	0.0113
NO, NDIR, lb/mile	0.0167	0.0112
Exhaust flow, SCF/mile	182	187

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[a] Corrected for background

TABLE F-2. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV 1 F Date Inspected December 12, 1968

Vehicle Description
Make/year IHC / 1962
Odometer, miles 271,778
Source/service Howell Refining Co / Tractor, tank transport
GVW, lb 27,000 Tire Size 10.00 X 20
Engine CID/cylinders 406 / 6
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 49.2

Preparation Data
At 30 mph level road, manifold vacuum was 14.0 in. Hg resulting in 30 hp rear wheel power (obs) at 1475 rpm engine speed. Timing was 14 °BTC at 680 rpm idle.
Observed engine condition Fair
Cycle Adjustment Acceleration shifting mode points were 18 mph in 2nd, 24 mph in 3rd, and 31 mph in 4th for this 4-speed transmission vehicle.
Time to reach end of accel shifting modes: 60 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	70	80	25	25
HC, FID, ppm C	55	75	--	--
CO, NDIR, %	0.18	0.22	--	--
CO_2, NDIR, %	0.8	0.7	--	--
NO_x, Saltz, ppm NO_2	46	46	22	22
NO, NDIR, ppm NO	110	110	40	40

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.00328	0.00392
HC, FID, lb/mile	0.00396	0.00515
CO, NDIR, lb/mile	0.262	0.306
CO_2, NDIR, lb/mile	1,370	1,230
NO_x, Saltz, lb/mile	0.0059	0.0057
NO, NDIR, lb/mile	0.0109	0.0108
Exhaust flow, SCF/mile	140	134

---

[a] Corrected for background

TABLE F-3. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-3 P Date Inspected December 22, 1968

Vehicle Description

Make/year IHC / 1963
Odometer, miles 314,014
Source/service Howell Refining Co / Tractor, gasoline transport
GVW, lb 27,000 Tire Size 10.00 X 20
Engine CID/cylinders 406 / 6
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 48.3

Preparation Data

At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 14 hp rear wheel power (rbs) at 1450 rpm engine speed. Timing was 10 °BTC at 675 rpm idle. Observed engine condition Fair
Cycle Adjustment Acceleration shifting mode points were 18 mph in 2nd, 24 mph in 3rd, and 31 mph in 4th for this 4-speed transmission vehicle.

Time to reach end of accel shifting modes 26 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	240	210	10	10
HC, FID, ppm C	320	300	"	"
CO, NDIR, %	0.42	0.445	"	"
CO_2, NDIR, %	0.8	0.8	"	"
NO_x, Saltz, ppm NO_2	46	69	23	23
NO, NDIR, ppm NO	90	100	30	30

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0171	0.0149
HC, FID, lb/mile	0.0238	0.0222
CO, NDIR, lb/mile	0.612	0.666
CO_2, NDIR, lb/mile	1.420	1.410
NO_x, Saltz, lb/mile	0.0063	0.0118
NO, NDIR, lb/mile	0.0101	0.0117
Exhaust flow, SCF/mile	200	175

---

*Corrected for background.

TABLE F-4. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-4 P Date Inspected December 22, 1968

Vehicle Description

Make/year IHC / 1962
Odometer, miles 179,182
Source/service Howell Refining Co / Tractor, gasoline transport
GVW, lb 27,000 Tire Size 10.00 X 20
Engine CID/cylinders 406 / 6
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 48.3

Preparation Data

At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 14 hp rear wheel power (rbs) at 1450 rpm engine speed. Timing was 12 °BTC at 450 rpm idle. Observed engine condition Poor
Cycle Adjustment Acceleration shifting mode points were 18 mph in 2nd, 24th in 3rd, and 31 mph in 4th for this 4-speed transmission vehicle.

Time to reach end of accel shifting modes 28 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	150	165	10	10
HC, FID, ppm C	170	190	"	"
CO, NDIR, %	0.345	0.33	"	"
CO_2, NDIR, %	0.8	0.8	"	"
NO_x, Saltz, ppm NO_2	46	69	23	23
NO, NDIR, ppm NO	90	90	30	25

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0104	0.0115
HC, FID, lb/mile	0.0125	0.0140
CO, NDIR, lb/mile	0.515	0.505
CO_2, NDIR, lb/mile	1.880	1.860
NO_x, Saltz, lb/mile	0.0063	0.0119
NO, NDIR, lb/mile	0.0102	0.0108
Exhaust flow, SCF/mile	137	138

---

*Corrected for background.

TABLE F-5. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-5 F Date Inspected December 29, 1968

Vehicle Description
Make/year IHC / 1963
Odometer, miles 646,656
Source/service Howell Refining Co. / Tractor, gasoline transport
GVW, lb 27,000 Tire Size 10.00 X 20
Engine CID/cylinders 406 / 6
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 48.3

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 13 hp rear wheel power (obs) at 1450 rpm engine speed. Timing was 12 °BTC at 550 rpm idle.
Observed engine condition Fair
Cycle Adjustment Accel shifting mode points were 18 mph in 2nd, 24 mph in 3rd, and 31 mph in 4th for this 4-speed transmission vehicle.

Time to reach end of accel shifting modes: 55 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	500	475	50	50
HC, FID, ppm C	600	570	--	--
CO, NDIR, %	0.43	0.395	--	--
CO_2, NDIR, %	0.7	0.7	--	--
NO_x, Saltz, ppm NO_2	46	46	--	--
NO, NDIR, ppm NO	130	140	75	80

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0318	0.0318
HC, FID, lb/mile	0.0421	0.0418
CO, NDIR, lb/mile	0.609	0.585
CO_2, NDIR, lb/mile	1.60	1.61
NO_x, Saltz, lb/mile	0.0108	0.0113
NO, NDIR, lb/mile	0.0093	0.0106
Exhaust flow, SCF/mile	180	174

---

*Corrected for background.

TABLE F-6. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-6 F Date Inspected December 28, 1968

Vehicle Description
Make/year IHC / 1962
Odometer, miles 353,016
Source/service Howell Refining Co. / Tractor, gasoline transport
GVW, lb 27,000 Tire Size 10.00 X 20
Engine CID/cylinders 406 / 6
Transmission type/speeds IHC (Manual) / 4
Axles, drive/dead 1 / 0 N/V 48.3

Preparation Data
At 30 mph level road, manifold vacuum was 13 in. Hg resulting in 13 hp rear wheel power (obs) at 1450 rpm engine speed. Timing was 10 °BTC at 500 rpm idle.
Observed engine condition Fair
Cycle Adjustment Accel shifting mode points were 18 mph in 2nd, 25 mph in 3rd, and 31 mph in 4th for this 4-speed transmission vehicle.

Time to reach end of accel shifting modes: 60 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	150	190	35	35
HC, FID, ppm C	170	210	--	--
CO, NDIR, %	0.285	0.285	--	--
CO_2, NDIR, %	0.7	0.7	--	--
NO_x, Saltz, ppm NO_2	46	46	--	--
NO, NDIR, ppm NO	140	145	80	90

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0087	0.0116
HC, FID, lb/mile	0.0126	0.0156
CO, NDIR, lb/mile	0.427	0.427
CO_2, NDIR, lb/mile	1.63	1.63
NO_x, Saltz, lb/mile	0.0114	0.0114
NO, NDIR, lb/mile	0.0108	0.0101
Exhaust flow, SCF/mile	180	180

---

*Corrected for background.

TABLE F-7. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-7-F Date Inspected December 2, 1968

Vehicle Description
Make/year Twin Coach / 1950
Odometer, miles --
Source/service City of San Antonio / Public transportation
GVW, lb 25,000 Tire Size 10.0 X 20
Engine CID/cylinders 404 / 6
Transmission type/speeds Spicer (Automatic) / 2
Axles, drive/dead 1 / 0 N/V 18.3

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 14 hp rear wheel power (obs) at 1750 rpm engine speed. Timing was 10 °BTC at 600 rpm idle.
Observed engine condition Good
Cycle Adjustment None. Specified WOT operation was employed during the acceleration shifting modes. Upshift occurred at 18 mph.

Time to reach end of accel shifting modes: 51 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	200	225	60	60
HC, FID, ppm C	175	175	--	--
CO, NDIR, %	0.185	0.178	--	--
CO_2, NDIR, %	0.60	0.63	--	--
NO_x, Saltz, ppm NO_2	22	23	--	--
NO, NDIR, ppm NO	138	165	92	80

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0097	0.0107
HC, FID, lb/mile	0.0118	0.0118
CO, NDIR, lb/mile	0.210	0.242
CO_2, NDIR, lb/mile	1,280	1,390
NO_x, Saltz, lb/mile	0.0052	0.0053
NO, NDIR, lb/mile	0.0135	0.0157
Exhaust flow, SCF/mile	122	128

---

*Corrected for background

TABLE F-8. CLASS IV VEHICLE INSPECTION SUMMARY EXPERIMENTAL CYCLE

Vehicle Number IV-8-F Date Inspected December 3, 1968

Vehicle Description
Make/year Twin Coach / 1950
Odometer, miles [illegible]
Source/service City of San Antonio / Public transportation
GVW, lb 25,000 Tire Size 10.00 X 20
Engine CID/cylinders 404 / 6
Transmission type/speeds Spicer (Automatic) / 2
Axles, drive/dead 1 / 0 N/V

Preparation Data
At 30 mph level road, manifold vacuum was 10.5 in. Hg resulting in 14 hp rear wheel power (obs) at 1725 rpm engine speed. Timing was 12 °BTC at 425 rpm idle.
Observed engine condition Good
Cycle Adjustment None. Upshift occurred at 18 mph. WOT operation was held.

Time to reach end of accel shifting modes: 53 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	190	178	55	60
HC, FID, ppm C	160	128	--	--
CO, NDIR, %	0.13	0.13	--	--
CO_2, NDIR, %	0.06	0.062	--	--
NO_x, Saltz, ppm NO_2	69	69	23	23
NO, NDIR, ppm NO	130	130	40	40

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0104	0.0083
HC, FID, lb/mile	0.0106	0.0087
CO, NDIR, lb/mile	0.273	0.287
CO_2, NDIR, lb/mile	1,260	1,430
NO_x, Saltz, lb/mile	0.0108	0.0108
NO, NDIR, lb/mile	0.0133	0.0135
Exhaust flow, SCF/mile	130	140

---

*Corrected for background

TABLE F-9. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-9-F
Date Inspected December 4, 1968

Vehicle Description
Make/year Twin Coach / 1950
Odometer, miles --
Source/service City of San Antonio / Public transportation
GVW, lb 23,000 Tire Size 10.00 X 20
Engine CID/cylinders 404 / 16
Transmission type/speeds Spicer (Automatic) / 2
Axles, drive/dead 1 / 0 N/V 34.2

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 13 hp rear wheel power (obs) at 1824 rpm engine speed. Timing was 12 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None. WOT operation was held through the initial acceleration modes.

Time to reach end of accel shifting modes: 56 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	190	165	30	30
HC, FID, ppm C	140	140	--	--
CO, NDIR, %	0.09	0.09	--	--
CO_2, NDIR, %	0.80	0.80	--	--
NO_x, Saltz, ppm NO_2	115	115	46	46
NO, NDIR, ppm NO	130	160	40	60

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0089	0.0090
HC, FID, lb/mile	0.0093	0.0093
CO, NDIR, lb/mile	0.167	0.121
CO_2, NDIR, lb/mile	1.695	1.695
NO_x, Saltz, lb/mile	0.0160	0.0161
NO, NDIR, lb/mile	0.0164	0.0121
Exhaust flow, SCF/mile	137	132

---

[a] Corrected for background

TABLE F-10. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-10-D
Date Inspected December 5, 1968

Vehicle Description
Make/year Twin Coach / 1950
Odometer, miles --
Source/service City of San Antonio / Public transportation
GVW, lb 23,000 Tire Size 10.00 X 20
Engine CID/cylinders 404 / 16
Transmission type/speeds Spicer (Automatic) / 2
Axles, drive/dead 1 / 0 N/V 34.2

Preparation Data
At 30 mph level road, manifold vacuum was 15.6 in. Hg resulting in 14 hp rear wheel power (obs) at 1833 rpm engine speed. Timing was 10 °BTC at 425 rpm idle.
Observed engine condition Good
Cycle Adjustment None. WOT operation was held through the initial acceleration modes.

Time to reach end of accel shifting modes: 56 sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	180	190	30	30
HC, FID, ppm C	150	150	--	--
CO, NDIR, %	0.115	0.113	--	--
CO_2, NDIR, %	0.75	0.75	--	--
NO_x, Saltz, ppm NO_2	69	69	23	23
NO, NDIR, ppm NO	130	120	30	30

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0090	0.0093
HC, FID, lb/mile	0.0100	0.0099
CO, NDIR, lb/mile	0.163	0.161
CO_2, NDIR, lb/mile	1.580	1.580
NO_x, Saltz, lb/mile	0.0106	0.0106
NO, NDIR, lb/mile	0.0128	0.0129
Exhaust flow, SCF/mile	142	156

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[a] Corrected for background

TABLE F-11. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-11 F Date Inspected December 6, 1969

Vehicle Description
Make/year Twin Coach / 1950
Odometer, miles --
Source/service City of San Antonio / Public transportation
GVW, lb 25,000 Tire Size 10.00 X 20
Engine CID/cylinders 404 / 16
Transmission type/speeds Spicer (Automatic) / 2
Axles, drive/dead 1 / 0 N/V 57.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 14 hp rear wheel power (obs) at 1710 rpm engine speed. Timing was 10 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None. WOT operation was held through the initial acceleration modes.

Time to reach end of accel shifting modes: 15 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	210	240	20	30
HC, FID, ppm C	300	263	--	--
CO, NDIR, %	0.26	0.23	--	--
CO_2, NDIR, %	0.70	0.70	--	--
NO_x, Saltz, ppm NO_2	46	46	23	23
NO, NDIR, ppm NO	130	130	68	65

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0189	0.0142
HC, FID, lb/mile	0.0201	0.0179
CO, NDIR, lb/mile	0.328	0.312
CO_2, NDIR, lb/mile	1.490	1.495
NO_x, Saltz, lb/mile	0.0053	0.0053
NO, NDIR, lb/mile	0.0179	0.0137
Exhaust flow, SCF/mile	137	131

---

*Corrected for background

Vehicle Number Date Inspected

Vehicle Description
Make/year
Odometer, miles
Source/service
GVW, lb Tire Size
Engine CID/cylinders
Transmission type/speeds
Axles, drive/dead N/V

Preparation Data
At 30 mph level road, manifold vacuum was in. Hg resulting in hp rear wheel power (obs) at rpm engine speed. Timing was °BTC at rpm idle.
Observed engine condition
Cycle Adjustment

Time to reach end of accel shifting modes: sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C				
HC, FID, ppm C				
CO, NDIR, %				
CO_2, NDIR, %				
NO_x, Saltz, ppm NO_2				
NO, NDIR, ppm NO				

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile		
HC, FID, lb/mile		
CO, NDIR, lb/mile		
CO_2, NDIR, lb/mile		
NO_x, Saltz, lb/mile		
NO, NDIR, lb/mile		
Exhaust flow, SCF/mile		

---

*Corrected for background

APPENDIX G

BASELINE EMISSIONS FROM BORDERLINE WEIGHT CATEGORY VEHICLES OPERATED ON TWO APPLICABLE EXPERIMENTAL CYCLES

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TABLE G-1. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-1a Date Inspected March 4, 1969

Vehicle Description
Make/year Chevrolet / 1969
Odometer, miles 3731
Source/service Avis Truck Rental / Stake, rental

GVW, lb 10,000 Tire Size 700 X 18
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 33.0

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 3.00 rear wheel power (obs) at 1650 rpm engine speed. Timing was 10 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 55 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	310	330	53	45
HC, FID, ppm C	590	670	—	—
CO, NDIR, %	0.308	0.35	—	—
CO_2, NDIR, %	0.60	0.60	—	—
NO_x, Saltz, ppm NO_2	46	46	23	23
NO, NDIR, ppm NO	33	30	—	—

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0178	0.0202
HC, FID, lb/mile	0.0380	0.0406
CO, NDIR, lb/mile	0.455	0.533
CO_2, NDIR, lb/mile	1.32	1.34
NO_x, Saltz, lb/mile	0.00865	0.00572
NO, NDIR, lb/mile	0.00374	0.00304
Exhaust flow, SCF/mile	122	123

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[a] Corrected for background.

TABLE G-2. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-1a Date Inspected March 4, 1969

Vehicle Description
Make/year Chevrolet / 1969
Odometer, miles 3731
Source/service Avis Truck Rental / Stake, rental

GVW, lb 10,900 Tire Size 700 X 18
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 33.0

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 3.00 rear wheel power (obs) at 1650 rpm engine speed. Timing was 10 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 55 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	320	355	45	45
HC, FID, ppm C	535	610	—	—
CO, NDIR, %	0.32	0.33	—	—
CO_2, NDIR, %	0.60	0.60	—	—
NO_x, Saltz, ppm NO_2	46	46	23	23
NO, NDIR, ppm NO	20	20	—	—

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0211	0.0235
HC, FID, lb/mile	0.0408	0.0458
CO, NDIR, lb/mile	0.506	0.540
CO_2, NDIR, lb/mile	1.43	1.43
NO_x, Saltz, lb/mile	0.0063	0.00619
NO, NDIR, lb/mile	0.00329	0.00326
Exhaust flow, SCF/mile	138	137

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[a] Corrected for background.

TABLE G-3. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-2a Date Inspected March 5, 1969

Vehicle Description
Make/year Ford / 1963
Odometer, miles 91,460
Source/service Ryder Truck Rental / Stake, rental

GVW, lb 9800 Tire Size 750 X 16
Engine CID/cylinders 223 / I-6
Transmission type/speeds Ford (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16.0 in. Hg resulting in 3 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 8 °BTC at 380 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	390	425	90	80
HC, FID, ppm C	690	665	35	40
CO, NDIR, %	0.18	0.18	--	--
CO_2, NDIR, %	0.60	0.70	--	--
NO_x, Saltz, ppm NO_2	92	69	33	46
NO, NDIR, ppm NO	25	25	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0224	0.0238
HC, FID, lb/mile	0.0415	0.0400
CO, NDIR, lb/mile	0.235	0.246
CO_2, NDIR, lb/mile	1.39	1.51
NO_x, Saltz, lb/mile	0.0061	0.0057
NO, NDIR, lb/mile	0.00394	0.00367
Exhaust flow, SCF/mile	128	124

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*Corrected for background

TABLE G-4. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-2a Date Inspected March 6, 1969

Vehicle Description
Make/year Ford / 1963
Odometer, miles 91,460
Source/service Ryder Truck Rental / Stake, rental

GVW, lb 9800 Tire Size 750 X 16
Engine CID/cylinders 223 / I-6
Transmission type/speeds Ford (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 16.0 in. Hg resulting in 3 hp rear wheel power (obs) at 1800 rpm engine speed. Timing was 8 °BTC at 380 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	425	400	70	70
HC, FID, ppm C	665	665	40	40
CO, NDIR, %	0.23	0.235	--	--
CO_2, NDIR, %	0.70	0.70	--	--
NO_x, Saltz, ppm NO_2	92	46	23	23
NO, NDIR, ppm NO	30	30	--	--

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0270	0.0257
HC, FID, lb/mile	0.0468	0.0484
CO, NDIR, lb/mile	0.378	0.364
CO_2, NDIR, lb/mile	1.64	1.70
NO_x, Saltz, lb/mile	0.0176	0.00620
NO, NDIR, lb/mile	0.00487	0.00396
Exhaust flow, SCF/mile	149	138

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*Corrected for background

TABLE G-5. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II-3a Date Inspected March 6, 1969

Vehicle Description
Make/year Ford / 1968
Odometer, miles 14,338
Source/service U-Haul Rental / Moving van, rental

GVW, lb 10,000 Tire Size 800 X 16.5
Engine CID/cylinders 300 / 6
Transmission type/speeds Ford (Automatic) / 3
Axles, drive/dead 1 / 0 N/V 60.9

Preparation Data
At 30 mph level road, manifold vacuum was 10.0 in. Hg resulting in 5.8hp. rear wheel power (obs) at 1825 rpm engine speed. Timing was 10 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment Initial WOT acceleration modes were operated at a 2 in. manifold vac setting such that normal automatic shifting occurred during the rapid accel to 33 mph.

Time to reach end of accel shifting modes: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	225	225	60	60
HC, FID, ppm C	390	390	--	--
CO, NDIR, %	0.28	0.265	--	--
CO_2, NDIR, %	0.7	0.7	--	--
NO_x, Saltz. ppm NO_2	69	69	21	21
NO, NDIR, ppm NO	35	35	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0112	0.0112
HC, FID, lb/mile	0.0229	0.0229
CO, NDIR, lb/mile	0.325	0.3005
CO_2, NDIR, lb/mile	1.47	1.47
NO_x, Saltz. lb/mile	0.0109	0.101
NO, NDIR, lb/mile	0.00335	0.00335
Exhaust flow, SCF/mile	108	108

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[a] Corrected for background

TABLE G-6. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-3a Date Inspected March 6, 1969

Vehicle Description
Make/year Ford / 1968
Odometer, miles 14,338
Source/service U-Haul Rental / Moving van, rental

GVW, lb 10,000 Tire Size 800 X 16.5
Engine CID/cylinders 300 / 16
Transmission type/speeds Ford (Automatic) / 3
Axles, drive/dead 1 / 0 N/V 60.9

Preparation Data
At 30 mph level road, manifold vacuum was 10.0 in. Hg resulting in 5.8hp. rear wheel power (obs) at 1825 rpm engine speed. Timing was 10 °BTC at 550 rpm idle.
Observed engine condition Good
Cycle Adjustment Initial WOT acceleration modes were operated at a 2 in. manifold vac setting such that normal automatic shifting occurred during the rapid accel to 33 mph.

Time to reach end of accel shifting modes: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	255	235	38	38
HC, FID, ppm C	320	360	--	--
CO, NDIR, %	0.24	0.235	--	--
CO_2, NDIR, %	0.70	0.70	--	--
NO_x, Saltz. ppm NO_2	118	92	23	23
NO, NDIR, ppm NO	45	45	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0139	0.0130
HC, FID, lb/mile	0.0225	0.0233
CO, NDIR, lb/mile	0.347	0.337
CO_2, NDIR, lb/mile	1.57	1.58
NO_x, Saltz. lb/mile	0.0215	0.0166
NO, NDIR, lb/mile	0.0065	0.0069
Exhaust flow, SCF/mile	116	114

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[a] Corrected for background

TABLE G-7. CLASS II VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number II 4a

Date Inspected September 4, 1968

Vehicle Description

Make/year Chevrolet / 1968
Odometer, miles 6050
Source/service Avis Truck Rental / Multipurpose stake, rental
GVW, lb 11,000 Tire Size 825 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 53.4

Preparation Data

At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 3.00 rear wheel power (obs) at 1600 rpm engine speed. Timing was 14 °BTC at 500 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	320	340	46	45
HC, FID, ppm C	570	610	40	13
CO, NDIR, %	0.175	0.163	--	--
CO_2, NDIR, %	0.65	0.60	--	--
NO_x, Saltz, ppm NO_2	73	93	21	22
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0182	0.0193
HC, FID, lb/mile	0.0361	0.0388
CO, NDIR, lb/mile	0.231	0.218
CO_2, NDIR, lb/mile	1.36	1.25
NO_x, Saltz, lb/mile	0.0163	0.0205
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	112.3	100.3

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[a] Corrected for background

TABLE G-8. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III 4a

Date Inspected April 29, 1968

Vehicle Description

Make/year Chevrolet / 1968
Odometer, miles 2273
Source/service Avis Truck Rental / Multipurpose stake, rental
GVW, lb 10,000 Tire Size 825 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 53.4

Preparation Data

At 30 mph level road, manifold vacuum was 16 in. Hg resulting in 3.00 rear wheel power (obs) at 1600 rpm engine speed. Timing was 4 °BTC at 560 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: -- sec

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	471	372	72	72
HC, FID, ppm C	920	810	--	--
CO, NDIR, %	0.79	0.70	--	--
CO_2, NDIR, %	0.68	0.62	0.045	0.045
NO_x, Saltz, ppm NO_2	58.0	43.9	8.60	8.60
NO, NDIR, ppm NO	--	--	--	--

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0335	0.0422
HC, FID, lb/mile	0.0612	0.0538
CO, NDIR, lb/mile	0.382	0.378
CO_2, NDIR, lb/mile	1.282	1.285
NO_x, Saltz, lb/mile	0.0079	0.0104
NO, NDIR, lb/mile	--	--
Exhaust flow, SCF/mile	104	113

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[a] Corrected for background

TABLE G-9. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-1b **Date Inspected** February 19, 1969

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 47,881
Source/service Avis Rental / Van

GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet / 4
Axles, drive/dead 1 / 0 N/V 62.5

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 7.00 rear wheel power (obs) at 1875 rpm engine speed. Timing was 10 °BTC at 525 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 42 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	415	415	45	45
HC, FID, ppm C	650	630	—	—
CO, NDIR, %	0.21	0.208	—	—
CO_2, NDIR, %	0.90	0.90	—	—
NO_x, Saltz, ppm NO_2	122	122	21	21
NO, NDIR, ppm NO	180	180	100	100

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0142	0.0142
HC, FID, lb/mile	0.0423	0.0421
CO, NDIR, lb/mile	0.281	0.272
CO_2, NDIR, lb/mile	1.66	1.695
NO_x, Saltz, lb/mile	0.0223	0.0226
NO, NDIR, lb/mile	0.0086	0.0087
Exhaust flow, SCF/mile	189	189

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[a] Corrected for background.

TABLE G-10. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL

Vehicle Number IV-1b **Date Inspected** February 19, 1969

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 47,881
Source/service Avis Rental / Van

GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 62.5

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 7.00 rear wheel power (obs) at 1875 rpm engine speed. Timing was 10 °BTC at 525 rpm idle.
Observed engine condition Good
Cycle Adjustment Acceleration shifting mode points were 13 mph in 2nd, 20 mph in 3rd, and 35 mph in 4th for this 4-speed vehicle.

Time to reach end of accel shifting modes: 51 sec.

Emissions, Concentration Basis

	Sample Run 1	Sample Run 2	Background Run 1	Background Run 2
HC, NDIR, ppm C	240	225	30	30
HC, FID, ppm C	470	380	—	—
CO, NDIR, %	0.155	0.145	—	—
CO_2, NDIR, %	0.5	0.5	—	—
NO_x, Saltz, ppm NO_2	92	92	18	—
NO, NDIR, ppm NO	150	150	75	75

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0153	0.0141
HC, FID, lb/mile	0.0303	0.0272
CO, NDIR, lb/mile	0.225	0.210
CO_2, NDIR, lb/mile	1.14	1.14
NO_x, Saltz, lb/mile	0.0186	0.0220
NO, NDIR, lb/mile	0.0123	0.0123
Exhaust flow, SCF/mile	106	106

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[a] Corrected for background.

TABLE G-11. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-2b Date Inspected February 20, 1969

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 23,592
Source/service Avis Rental / Stake

GVW, lb 17,500 Tire Size 825 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 13.1 in. Hg resulting in 2 hp. rear wheel power (obs) at 1800 rpm engine speed. Timing was 12 °BTC at 750 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 53 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	280	280	80	30
HC, FID, ppm C	610	720	30	30
CO, NDIR, %	0.43	0.29		
CO_2, NDIR, %	0.8	0.8		
NO_x, Saltz, ppm NO_2	69	94	23	23
NO, NDIR, ppm NO	25	35	0	0

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0204	0.0228
HC, FID, lb/mile	0.0276	0.0437
CO, NDIR, lb/mile	0.348	0.309
CO_2, NDIR, lb/mile	1.6	1.73
NO_x, Saltz, lb/mile	0.0102	0.0135
NO, NDIR, lb/mile	0.00361	0.00443
Exhaust flow, SCF/mile	147	150

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*Corrected for background

TABLE G-12. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-2b Date Inspected February 20, 1969

Vehicle Description
Make/year Chevrolet / 1967
Odometer, miles 23,592
Source/service Avis Rental / Stake

GVW, lb 19,500 Tire Size 825 X 20
Engine CID/cylinders 250 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0 N/V 60.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.5 in. Hg resulting in 5 hp. rear wheel power (obs) at 1800 rpm engine speed. Timing was 12 °BTC at 750 rpm idle.
Observed engine condition Good
Cycle Adjustment Acceleration shifting mode points were 17 mph in 2nd, 28 mph in 3rd, and 33 mph in 4th for this 4-speed transmission vehicle.

Time to reach end of accel shifting modes: 54 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	260	220	100	40
HC, FID, ppm C	450	380	100	
CO, NDIR, %	0.4	0.4		
CO_2, NDIR, %	0.7	0.7		
NO_x, Saltz, ppm NO_2	86	69	23.1	23.1
NO, NDIR, ppm NO	80	80	0	0

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0119	0.0131
HC, FID, lb/mile	0.0254	0.0276
CO, NDIR, lb/mile	0.290	0.292
CO_2, NDIR, lb/mile	1.60	1.61
NO_x, Saltz, lb/mile	0.0110	0.0085
NO, NDIR, lb/mile	0.00603	0.0063
Exhaust flow, SCF/mile	120	121

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*Corrected for background

TABLE G-13. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-3b Date Inspected February 21, 1969

Vehicle Description
Make/year Ford / 1968
Odometer, miles 20,938
Source/service Ryder Rental / Rental

GVW, lb 20,000 Tire Size 825 X 20
Engine CID/cylinders 330 / V-8
Transmission type/speeds Ford (Manual) / 5
Axles, drive/dead 1 / 0 N/V 70.0

Preparation Data
At 30 mph level road, manifold vacuum was 15.0 in. Hg resulting in 5.0hp rear wheel power (obs) at 2100 rpm engine speed. Timing was 12 °BTC at 650 rpm idle.
Observed engine condition Good
Cycle Adjustment Acceleration shifting mode points were 17 mph in 2nd, 24 mph in 3rd, 28 mph in 4th, and 33 mph in 5th for this 5 speed transmission vehicle.

Time to reach end of accel shifting modes: 48 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	1180	1220	20	30
HC, FID, ppm C	2100	2130	89	100
CO, NDIR, %	0.153	0.153	—	—
CO_2, NDIR, %	1.0	0.93	—	—
NO_x, Saltz, ppm NO_2	135	89	11	11
NO, NDIR, ppm NO	80	90	11	11

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0782	0.0824
HC, FID, lb/mile	0.1416	0.141
CO, NDIR, lb/mile	0.216	0.216
CO_2, NDIR, lb/mile	2.19	2.09
NO_x, Saltz, lb/mile	0.0363	0.0149
NO, NDIR, lb/mile	0.0120	0.0133
Exhaust flow, SCF/mile	191	180

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*Corrected for background

TABLE G-14. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-3b Date Inspected February 21, 1969

Vehicle Description
Make/year Ford / 1968
Odometer, miles 20,938
Source/service Ryder Rental / Rental

GVW, lb 20,000 Tire Size 825 X 20
Engine CID/cylinders 330 / V-8
Transmission type/speeds Ford (Manual) / 5
Axles, drive/dead 1 / 0 N/V 70.00

Preparation Data
At 30 mph level road, manifold vacuum was 15.0 in. Hg resulting in 5.0hp rear wheel power (obs) at 2100 rpm engine speed. Timing was 12 °BTC at 650 rpm idle.
Observed engine condition Good
Cycle Adjustment None

Time to reach end of accel shifting modes: 33 sec.

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	710	640	41	30
HC, FID, ppm C	1250	1180	100	100
CO, NDIR, %	0.09	0.08	—	—
CO_2, NDIR, %	0.93	0.93	—	—
NO_x, Saltz, ppm NO_2	115	115	22	11
NO, NDIR, ppm NO	80	65	13	13

Emissions, Mass Basis*

	Run 1	Run 2
HC, NDIR, lb/mile	0.0464	0.0461
HC, FID, lb/mile	0.0805	0.0825
CO, NDIR, lb/mile	0.112	0.128
CO_2, NDIR, lb/mile	2.08	2.30
NO_x, Saltz, lb/mile	0.0266	0.0233
NO, NDIR, lb/mile	0.0122	0.00513
Exhaust flow, SCF/mile	158	178

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*Corrected for background

TABLE G-15. CLASS III VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number III-4b   Date Inspected February 24, 1969

Vehicle Description
Make/year Chevrolet / 1966
Odometer, miles 33,796
Source/service Avis Rental / Van

GVW, lb 19,500   Tire Size 825 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0   N/V 63.4

Preparation Data
At 30 mph level road, manifold vacuum was 15 in. Hg resulting in 5 hp rear wheel power (obs) at 1900 rpm engine speed. Timing was 10 °BTC at 720 rpm idle.
Observed engine condition Fair
Cycle Adjustment None

Time to reach end of accel shifting modes: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	400	355	45	45
HC, FID, ppm C	630	535	30	30
CO, NDIR, %	0.0200	0.20	—	—
CO_2, NDIR, %	0.70	1.90	—	—
NO_x, Saltz, ppm NO_2	113	92	21	21
NO, NDIR, ppm NO	80	70	40	30

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0246	0.0206
HC, FID, lb/mile	0.0419	0.0334
CO, NDIR, lb/mile	0.285	0.263
CO_2, NDIR, lb/mile	1,530	1,870
NO_x, Saltz, lb/mile	0.0166	0.0119
NO, NDIR, lb/mile	0.00789	0.00605
Exhaust flow, SCF/mile	172	164

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[a] Corrected for background

TABLE G-16. CLASS IV VEHICLE INSPECTION SUMMARY
EXPERIMENTAL CYCLE

Vehicle Number IV-4b   Date Inspected February 24, 1969

Vehicle Description
Make/year Chevrolet / 1966
Odometer, miles 33,796
Source/service Avis Truck Rental / Van, rental

GVW, lb 19,500   Tire Size 825 X 20
Engine CID/cylinders 292 / L6
Transmission type/speeds Chevrolet (Manual) / 4
Axles, drive/dead 1 / 0   N/V 63.4

Preparation Data
At 30 mph level road, manifold vacuum was 14 in. Hg resulting in 5 hp rear wheel power (obs) at 1900 rpm engine speed. Timing was 10 °BTC at 720 rpm idle.
Observed engine condition Fair
Cycle Adjustment Acceleration shifting mode points were 16 mph in 2nd, 30 mph in 3rd, and 35 mph in 4th for this 4-speed transmission vehicle.

Time to reach end of accel shifting modes: 30 sec

Emissions, Concentration Basis

	Sample		Background	
	Run 1	Run 2	Run 1	Run 2
HC, NDIR, ppm C	225	225	60	60
HC, FID, ppm C	325	325	—	—
CO, NDIR, %	0.095	0.105	—	—
CO_2, NDIR, %	0.70	0.70	—	—
NO_x, Saltz, ppm NO_2	92	92	21	23
NO, NDIR, ppm NO	65	65	35	0

Emissions, Mass Basis[a]

	Run 1	Run 2
HC, NDIR, lb/mile	0.0121	0.0122
HC, FID, lb/mile	0.0226	0.0221
CO, NDIR, lb/mile	0.132	0.144
CO_2, NDIR, lb/mile	1.59	1.51
NO_x, Saltz, lb/mile	0.0130	0.0123
NO, NDIR, lb/mile	0.00643	0.00559
Exhaust flow, SCF/mile	129	127

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[a] Corrected for background